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54th Annual Meeting

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June 20–23, 1946

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Lamme Award—Harry Parker Hammond

To Harry Parker Hammond for his lifelong devotion to the advancement of engineering education, his vision of its responsibilities, his wisdom in plotting its course, and his skill in crystallizing, for that purpose, the wisdom of others; for the clarity and force of his language in stating its methods and philosophy; for his ability, as teacher and administrator, in carrying out its great ideals and in giving to students his own high sense of their calling.

HARRY PARKER HAMMOND, the eighteenth Lamme medalist of the Society for the Promotion of Engineering Education, was born at Asbury Park, New Jersey on December 21, 1884. He was graduated from the University of Pennsylvania with the degree of Bachelor of Science in Civil Engineering in 1909 and subsequently was awarded the degree of Civil Engineer by that institution. He was given the honorary degree of Doctor of Engineering by the Case School of Applied Science in 1931 and that of Doctor of Laws by the University of Vermont in 1943.

He served as instructor in civil engineering at the University of Pennsylvania from 1909 to 1911 and at Lehigh University in the following year. In 1912 he became Assistant Professor of Civil Engineering at the Polytechnic Institute of Brooklyn and five years later was appointed Professor of Sanitary-Hydraulic Engineering there. In 1927 he became Professor of Civil Engineering and Head of the Department, remaining in that position for ten years. In 1937 he was appointed Dean of the School of Engineering at Pennsylvania State College and still holds that position.

As an engineer, Dean Hammond has worked with the American Bridge Company, the Board of Water Supply, City of New York, the Miami Conservation District, Ohio, and others. As a consultant on engineering education, he has served the states of Georgia, with two reports, Missouri, and Virginia, as well as Brown University, Cooper Union, and Catholic University.

His great interest in engineering education and his influence upon it have been manifested most directly by the exceptional contributions which he has made to the Society for the Promotion of Engineering Education over a period of twenty years. From 1924 to 1927 he was Associate Director of the Investigation of Engineering Education then in progress under the Board of Investigation and Coordination. In 1927 he organized the Society's summer schools for engineering teachers and acted as their director until 1933. In 1939–40 he was Chairman of the Committee on Aims and Scope of Engineering Education and, in 1943–44, Chairman of the Committee on Engineering Education After the War. In addition, he was a member of the Committee on Graduate Study from 1924 to 1936, and is now Chairman of the Division on Humanistic-Social Studies. He served the Society as its Vice President in 1934–35 and as President in 1936–37. He was an elected member of the

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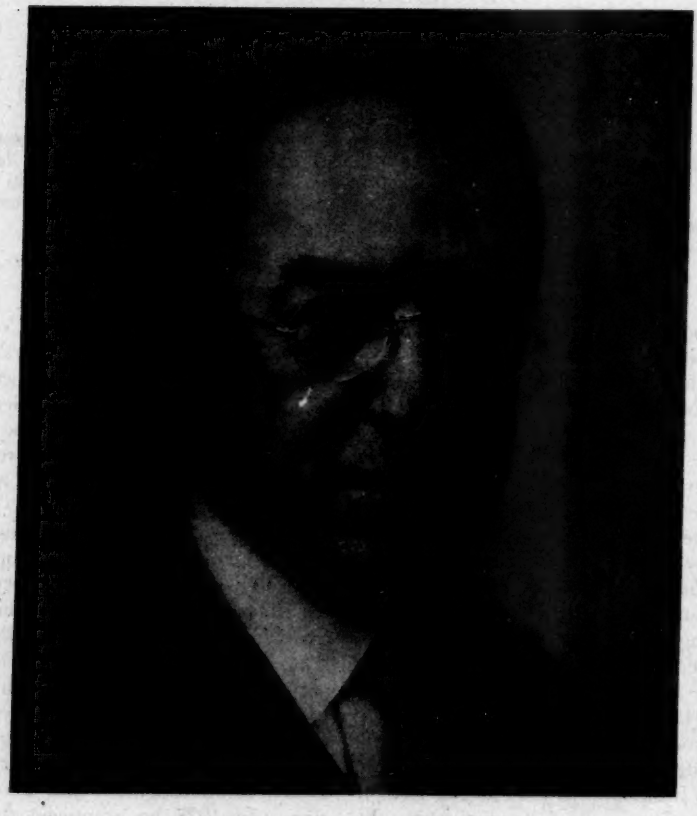

HARRY PARKER HAMMOND

RECIPIENT OF LAMME AWARD, 1945

Council from 1927 to 1930 and has been an ex-officio member as Past President since 1937.

In the work of the Engineers' Council for Professional Development, Dean Hammond was Chairman of the Interim Committee on Engineering Schools during the Council's formative period and later served that committee as a member from 1936 to 1939, as Vice Chairman in 1938–39, and as Chairman of the Delegatory Committee for New England. He is now Chairman of the Sub-Committee on Technical Institutes. Dean Hammond has been a member of the Legislative Committee of the Engineering College Research Association and a member of the Committee on Construction Engineering Education of the American Society of Civil Engineers.

His activities for the Federal Government began with his service as Chairman, Local Board of Division 58

New York City, under the Selective Service Act during the First World War. During the present war, he has been a member of the National Advisory Committee, Engineering, Science and Management War Training Program, U. S. Office of Education, a member of the Civilian Advisory Board to the Military Training Division, Army Ordnance Department, and Coordinator of the Committees of Academic Visitors, Army Specialized Training Program, Third Service Command.

Dean Hammond's publications, principally in the JOURNAL OF ENGINEERING EDUCATION and the publications of the American Society of Civil Engineers, include many papers and reports on various aspects of engineering education. They demonstrate the long and deep study, the discriminating judgment and creative vision he has devoted to improvement of its techniques and establishment of its basic philosophy. In particular, the committee reports on the Aims and Scope of Engineering Education and Engineering Education After the War, to which as Chairman he made the greatest contribution, stand as landmarks destined to guide its development for a long time.

Although such contributions and his work as an administrator have demanded most of Dean Hammond's time in recent years, he has maintained his contacts with individual students and continued his invaluable series of talks to freshmen concerning the engineering profession. In earlier years, his teaching was marked by his skill in emphasizing essentials and in using varied methods, his patience, and his concern for both exactness of learning and the overall development of the student. Later his emphasis upon the thesis and research work of his department at the Polytechnic Institute of Brooklyn helped to enrich all of its work and to develop creative as well as analytical abilities in the students.

Dean Hammond is a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the Newcomen Society, and also of Phi Kappa Phi, Tau Beta Pi, Delta Kappa Phi and Triangle.

In September, 1913, he married Margaret L. Raymond, daughter of the late Dean William G. Raymond, one of the founders of the Society for the Promotion of Engineering Education and its President in 1911–12. Their home is at State College, Pennsylvania.

RECIPIENTS OF S.P.E.E. LAMME MEDAL

1928—George Fillmore Swain
1929—Irving Porter Church
1930—Charles Felton Scott
1931—Dugald Caleb Jackson
1932—Arthur Newell Talbot
1933—Dexter Simpson Kimball
1934—Edward Rose Maurer
1935—William Elgin Wickenden
1936—Herman Schneider
1937—Frederick Eugene Turneaure
1938—Robert Lemuel Sackett
1939—Stephen P. Timoshenko
1940—Andrey A. Potter
1941—Anson Marston
1942—Roy Andrew Seaton
1943—Thomas Ewing French
1944—Hardy Cross
1945—Harry Parker Hammond

Report on the Activities of the Committee on Revision of the Constitution and By-Laws

By H. S. ROGERS

Chairman, Committee on Revision of the Constitution and By-Laws

At the meeting of the Council of the Society in Pittsburgh, the first and second of this June, the Council requested the President to have a series of articles prepared for the JOURNAL upon the study and work of the Committee on Revision of the Constitution and By-Laws. This article is the introductory one of such a series and presents a brief historical statement of the work of the Committee to date. In subsequent articles the need for revision, the results desired through revision, the plan of organization, and the details of the Constitution and By-Laws will be presented.

At the Council meeting of the Society in June 1944 at Cincinnati it was voted that the incoming President should appoint a committee "to review the Constitution and By-Laws of the Society for the purpose of adapting the organization of the Society to the needs of the present time, and submit such recommendations as the committee sees fit to the Council (preferably at the October 1944 meeting)."

Pursuant to this action your President appointed a committee of sixteen members on August 7, 1944, with membership widely distributed geographically as well as among the Divisions of the Society as follows:

G. F. Bateman
H. O. Croft
R. E. Doherty
L. J. Fletcher
S. C. Hollister
Frank Kerekes
A. B. Domonoske
A. A. Potter
R. A. Seaton
A. R. Stevenson
B. R. Van Leer
F. C. Vilbrandt
W. E. Wickenden
W. R. Woolrich
C. R. Young
H. S. Rogers, *Chairman*

He also appointed a sub-committee of five to draft the Constitution and By-Laws for consideration and approval of the main committee. This sub-committee was under the Chairmanship of R. E. Doherty, past President of the Society, and included A. A. Potter, Chairman of the Administrative Division, W. R. Woolrich, President of the Engineering College Research Association, H. O. Croft, and W. E. Wickenden, with the President and Secretary ex officio.

The Drafting Committee first met in Pittsburgh on September 9 and 10, 1944, and prepared their preliminary general plan of organization in dia-

grammatical form. This plan was reviewed by the entire Committee on Revision of the Constitution at a meeting in Chicago on October 22, and also by the Council of the Society. The discusion by the General Committee and the Council contributed a number of revisions to the general plan which was then approved by the Council as a basis for the drafting of a Constitution, provided that the plan be acceptable to the Engineering College Research Association.

At a subsequent meeting of the Drafting Committee, and the Executive Committee of E.C.R.A. in Pittsburgh on February 4, 1945, a number of problems involved in the contemplated consolidation of the two organizations were resolved and general agreement was secured upon an outline of an organization which it was felt would meet "the needs of the present time."

Following this preliminary agreement with regard to structure and procedures, a first draft of a Constitution was prepared and submitted for criticism to the Committee on Revision of the Constitution, the Executive Committee of E.C.R.A., and the Council of S.P.E.E. From these bodies a number of further suggestions were submitted which were incorporated in a second draft of the Constitution by the Drafting Committee at the time the Council of the Society met in Pittsburgh on June first and second of this year.

This second draft has subsequently been circulated among the above mentioned groups and this circulation marks the progress in the study and work to date.

Because so many suggestions were received just prior to the Pittsburgh meeting of the Council it was not possible for the Drafting Committee to present the Constitution and By-Laws for discussion at the Council meeting. A report of progress was, however, made and it is understood, of course, that as soon as the general Committee on Revision has had an opportunity to review and approve the suggested revisions, and when the opportunity presents itself, the Council of the Society will again have an opportunity to review and to discuss the draft and will determine the course of subsequent action.

Minutes of Council Meetings, June 1-2, 1945, Pittsburgh, Pa.

Present: H. S. Rogers, N. W. Dougherty, H. M. Crothers, F. L. Bishop, H. O. Croft, R. A. Deller, H. L. Dodge, R. E. Doherty, S. B. Earle, J. C. Elgin, E. L. Eriksen, O. J. Ferguson, A. F. Greaves-Walker, A. M. Greene, H. P. Hammond, H. T. Heald, D. C. Jackson, C. E. Lawall, A. A. Potter, D. B. Prentice, R. L. Sackett, Thorndike Saville, R. A. Seaton, R. H. Spahr, C. E. Tucker, F. C. Vilbrandt, A. H. White, W. C. White, W. E. Wickenden, F. L. Wilkinson, W. R. Woolrich. 31.

The following actions were taken:

1. The report of the Secretary accepted and ordered printed in the JOURNAL.

2. The report of the auditor accepted and ordered printed in the JOURNAL.

3. It was the unanimous judgment of the Council that the present officers and members of the Council should hold over under the Constitution until their successors are elected at the next regular meeting of the Society.

4. The invitation to meet in St. Louis, Mo., June 24–28, 1946, Washington University host, was accepted. (These dates, at the request of Washington University, have since been changed to June 20–23, 1946.)

5. Chairman Grinter summarized the report on Graduate Study which is published in the June JOURNAL. Council expressed its deep appreciation to the Chairman and his committee for the excellent work they had done.

6. K. W. Vaughn and R. L. Sackett reported on the progress of the selection and guidance project.

7. President Rogers was authorized to appoint a committee to draw up a plan for awarding a special prize to those who make significant contributions to engineering education in the teaching field. The following committee was appointed: H. L. Dodge, Chairman, H. O. Croft, H. E. Dyche, H. P. Hammond, H. S. Rogers, W. R. Woolrich.

8. Administrative Division: Chairman Potter reported that due to conflicting duties he had resigned as chairman of the Division and that the Executive Committee of the Division had selected S. C. Hollister, Cornell University, as Chairman.

S. S. Steinberg reported on surplus property.

S. C. Hollister reported on military training.

Thorndike Saville reported on federal research activities.

A. A. Potter made a brief report on academic tenure, consulting services, and professional responsibilities for the committee headed by C. J. Freund. It was recommended that Dean Freund be asked to revise and abbreviate this report and have it published in the JOURNAL as a progress report; and that the Administrative Division ask him to continue his study.

A. A. Potter reported on the activities of the Division as a whole.

9. F. L. Bishop elected a represen-

tative of the Society on the American Council on Education.

10. D. B. Prentice elected a representative of the Society on the Engineers' Council for Professional Development.

11. S. S. Steinberg was requested to act as the Society's' ambassador of good will in connection with his visit to the engineering colleges of Latin America this summer as a representative of the State Department.

12. Authorization was given to the Mineral Technology Division to change its name to MINERAL ENGINEERING DIVISION as requested.

13. The establishment of a Division on Graduate Study approved.

14. President Rogers, in consultation with H. T. Heald, will appoint a committee on safety.

15. A request for a representative on S.A.E. committee on drafting was turned over to the chairmen of the Division on Drawing and the Committee on Aeronautical Engineering.

16. W. R. Woolrich reported on Engineering College Research Association. Council authorized the President to make overtures to the Engineers Joint Council whereby the President and the Secretary of the Society might participate as members of that Council.

17. D. B. Prentice presented a report on E.C.P.D. This will be published in the JOURNAL.

18. H. P. Hammond reported on accrediting of technical institutes.

19. H. P. Hammond reported on activities of Division on Humanistic-Social Studies.

20. F. C. Vilbrandt spoke on expediting the return of veterans to colleges; the proselyting of instructors; and a summer school for chemical engineering next year.

21. O. J. Ferguson gave an analysis of A.S.T. credits. The report will be published in the JOURNAL.

22. A committee, O. J. Ferguson, Chairman, D. B. Prentice, and N. W. Dougherty, was asked to study the question of credits for degrees in the Army and the Navy programs.

23. The Administrative Division was asked to study the programs of the Army and the Navy looking toward the establishment of a clearing house of information on proposed plans and changes in curricula.

24. The Administrative Division was asked to arrange for a meeting of this Division before the beginning of the fall term, if possible.

25. It was the consensus of Council that women should have the same right in engineering colleges as men including membership in national and local professional and honorary societies. A. A. Porter will write re their membership in the A.A.U.W.

26. The President and the Secretary instructed to communicate with the American Council on Education advising the Council of the suggestion made by Dean Bunker of M.I.T. and presented by D. C. Jackson, and ask the Council as to whether from the standpoint of national policy it is desirable to approach Selective Service, State Dept., or Dr. Duggan to bring about modifications.

27. Thirty-three individual and 2 institutional members were elected.

ANGELO, ERNEST J., Assistant Professor of Electrical Engineering, Tulane University, New Orleans, La. C. W. Ricker, J. M. Robert.

AZPELL, EDWARD W., Instructor in Mechanical Engineering, Purdue University, Lafayette, Ind. H. L. Solberg, D. S. Clark.

BAKER, JOHN F., Professor of Mechanical Sciences, Cambridge University, Cambridge, England. F. L. Bishop, Nell McKenry.

BOGGS, ARTHUR B., Instructor in Mathematics, Michigan College of M. & T., Houghton, Mich. L. A. Rose, J. M. Harrington.

DAVIS, VICTOR L., Instructor in Radio, Alamo City Business College, San Antonio, Texas. H. P. Graves, E. E. Booher.

DERWIN, JAMES V., Specialist in Engineering Education, ESMWT, U. S. Office of Education, Washington, D. C. R. L. Peurifoy, G. W. Case.

GOLDSTEIN, MILTON, Instructor in Radio Engineering, Chicago Technical College, Chicago, Ill. L. O. Gorder, C. Morey.

GONCE, WILLIAM P., Director, Engineering Training School, Glenn L. Martin Co., Towson, Md. S. S. Steinberg, W. B. Kouwenhoven.

HAGEN, R. R., Instructor in Mechanical Engineering, Michigan College of M. & T., Houghton, Mich. W. A. Longacre, L. A. Rose.

HOLCOMB, GLENN W., Professor of Civil Engineering, Oregon State College, Corvallis, Ore. Re-admission.

HOLDERMAN, K. L., Assistant Professor of Engineering Extension, The Pennsylvania State College, State College, Pa. E. L. Keller, C. G. Reen.

JOHNSON, ERNEST J., Director, Canadian Branch, Technological Institute of Great Britain, 416 Bloor St., East, Toronto, Canada. F. L. Bishop, Nell McKenry.

JOHNSON, HAROLD A., Assistant Professor of Mechanical Engineering, University of California, Berkeley, Calif. E. D. Howe, R. G. Folsom.

LOBERG, HARRY J., Associate Professor of Administration Engineering, Cornell University, Ithaca, N. Y. M. W. Sampson, S. S. Garrett.

MACK, ROBERT P., Assistant in Electrical Engineering, Massachusetts Institute of Technology, Cambridge, Mass. R. H. Frazier, C. E. Tucker.

MACKIN, F. L., Chairman, Machine Shop Dept., General Motors Institute, Flint, Mich. C. A. Brown, R. H. Spahr.

MACLEAN, CHARLES W., Assistant Director of Education, Westinghouse Electric Corp., East Pittsburgh, Pa. E. E. Pendray, J. C. McKeon.

MCEACHRON, KARL B., Engineering General Division, General Electric Co., Schenectady, N. Y. A. R. Stevenson, M. M. Boring. Re-admission.

MENDENHALL, WALTER G., Instructor in Mechanical Engineering, North Carolina State College, Raleigh, N. C. W. E. Adams, L. L. Vaughan.

MITCHELL, ADOLPHUS, Associate Professor of Engineering Mechanics, North Carolina State College, Raleigh, N. C. G. W. Smith, N. W. Conner.

MOREHISER, JOHN E., Instructor in Mechanical Engineering, Tulane University, New Orleans, La. J. M. Robert, A. M. Hill.

PATTERSON, G. R., Carnegie Institute of Technology, Pittsburgh, Pa. Re-admission.

PERRY, C. CARLETON, Assistant Director, YMCA College, Dayton, Ohio. W. R. Weems, J. P. Vidosic.

ROBERTSON, ANDREW, Professor of Mechanical Engineering, University of Bristol, Bristol, England. F. L. Bishop, Nell McKenry.

SEARS, FRANCIS W., Professor of Physics, Massachusetts Institute of Technology, Cambridge, Mass. C. E. Bennett J. G. Potter.

SOLLENBERGER, R. CLEM, Executive Secretary Conveyor Association, 1219 Eye St., N.W., Washington 5, D. C. E. R. Rath, Nell McKenry.

STEELE, WESTBROOK, Executive Director, Institute of Paper Chemistry, 132 No. Green Bay, Appleton, Wis. A. R. Stevenson, F. L. Bishop.

SWAN, PAUL R., Director, Publicity, Placement and Student Activities, Worcester Polytechnic Institute, Worcester, Mass. F. J. Adams, F. W. Roys.

TEPLO, LEO, Assistant to Vice President, Allis-Chalmers Company, Milwaukee, Wis. W. D. Bliss, F. T. Agthe.

TERMAN, FRED E., Director, Radio Research Lab., Harvard University; Dean, School of Engineering, Stanford University on leave; Cambridge, Mass. H. H. Skilling, E. L. Grant.

VAN HORN, ROBERT B., Professor of Hydraulic Engineering, Head, Dept. Civil Engr., University of Washington, Seattle, Wash. Re-admission.

VAN ZILE, LAWRENCE W., Assistant Engineer, Network Dept., Public Service Co.; Extension Instructor, E.E., Newark College of Engineering and Rutgers Univ. J. C. Peet, F. N. Entwisle.

WAYMACK, REX W., Draftsman and Designer, B. and N. Engineering Service,

622 Haney Ave., So. Bend, Ind. W. W. Turner, C. C. Stevason.

Active institutional membership:

Institute of Radio Engineers, 330 West 42nd St., New York 18, N. Y. George W. Bailey, Executive Secretary.

Associate institutional membership:

Bridgeport Engineering Institute, Bridgeport 4, Conn. John Shallenberger, Secretary.

28. The Executive Committee was instructed to look into the question of indexing the *Proceedings* and if the cost appears reasonable to secure someone to do the work. The report of the investigation of engineering education is to be included in the index.

29. The request to publish in the year book all society affiliations of the members was refused. This information is in "Who's Who."

30. The Society will sponsor, without cost to it, the third hydraulic conference at the University of Iowa.

31. H. S. Rogers made a progress report on the revision of the Constitution and By-Laws.

32. President Rogers, beginning with the September JOURNAL, will provide a page each month on the revision of the Constitution and By-Laws of the Society.

33. The following budget was approved:

RECEIPTS:		
Current dues—individual	$14,500.00	
institutional	2,370.00	$16,870.00
Back dues		1,000.00
Advertising		3,500.00
Sale of publications		650.00
Interest, government bonds		218.75
Refund, Lamme medal		191.00
Total estimated receipts		$22,429.75
DISBURSEMENTS:		
Meeting	$ 500.00	
JOURNAL and *Proceedings*	10,000.00	
Committees and conferences	500.00	
Secretary's honorarium	2,000.00	
Clerical assistance	4,300.00	
Postage and supplies	1,500.00	
Travel of officers	300.00	
Travel, Secretary's office	400.00	
Administrative Division	1,000.00	
Emergency fund	1,000.00	
Dues, Amer. Council Education	100.00	
E.C.P.D. Engineering Schools	500.00	
Mechanics Division	100.00	
Measurement and guidance	300.00	
Drawing Division, summer school	200.00	
Graduate study	200.00	
Civil Engineering Division	300.00	
Revision Constitution and By-Laws	1,000.00	$24,200.00
Estimated deficit for 1945–46		$ 1,770.25

Respectfully submitted,
F. L. BISHOP,
Secretary

Address*

By H. S. ROGERS

President of the Society; President, Polytechnic Institute of Brooklyn

The Secretary informed me that I was supposed to give an address at this meeting. I told him that I did not think it would be appropriate to give a presidential address, but if he thought it necessary, I would endeavor to say something regarding engineering education that might be related to the deliberations of the occasion. I have decided to point out certain things about engineering education which I discovered as the result of a rash discussion which I had with Secretary Bishop.

When it was time to publish the yearbook, we were discussing the selection of an article to put in the front of the book, because the second class postage rates required that such an article be there in order to take advantage of those rates. I asked him what had been put in before. He told me that the year before they had put the survey of engineering registrations in the yearbook and the Society couldn't find them. "Well," I said, "If we want to bury something, why don't we put the history of the Society in there?" He said, "Who is going to do it?" I said, "Hammond is the man to do it, but we have him loaded down so now I wouldn't have the courage to ask him." He said, "Then it is up to you, you've got to do it," and in a rash moment I said I would, because I thought I could turn to the writings of Hammond and Wickenden and Potter and Sackett, and find it pretty well canned.

I went back to my S.P.E.E. files and found out that when they talked, they talked principally about engineering education, rather than about the S.P.E.E. I was, therefore, saddled with a very arduous task of digging up some of the facts regarding the chronology of S.P.E.E. and of engineering education prior to the formation of the Society, and as I did that, I found some very interesting facts.

A summary of them was put into this little announcement of the aims and organization of the Society for the Promotion of Engineering Education, which all of you have received through the mail, pointing out that engineering education can be divided into three definite eras: one, the formative era, prior to 1893, during which engineering schools were inaugurated and curriculus established; the second, the era of program development between 1893 and 1918, during which emphasis was placed upon the development of courses as units of curricula and upon the expansion of curricula; and a third one, the era of personalized education between 1918 and 1944.

When one gets into the study of the facts, there are some very striking de-

*Delivered at a meeting of Pittsburgh members, S.P.E.E., Schenley Hotel, Pittsburgh, Pa., June 1, 1945.

ductions. In general, our curricula were inaugurated very closely to that year in which the Associated Founders' Societies were developed. That isn't exactly true, but there is a close coordination, and quite logically, of course, the civil engineering curriculum was the first. We speak of that sometimes as being inaugurated in Rensselaer in 1824, but if one digs back into that history one finds that along in the '30's, the first degree was given at Rensselaer for one year's work, and along about 1850 the program was increased from one to three years. One finds that the early curriculum consisted of courses in mathematics, physics, chemistry and surveying, with some general courses about construction.

It was only in the period of the '60's or early '70's that the civil engineering curriculum began to take on a form similar to that form which it has today.

The A.S.C.E. was founded in '52, shortly after the curriculum at Rensselaer was increased to three years. There was a slow period of development between 1852 and the passage of the Land Grant College Act. The Land Grant College Act, however, gave great impetus to the development of engineering schools and of state colleges, and the other curricula came along rather rapidly, mining next, mechanical next, electrical growing out of physics and chemical engineering growing out of industrial chemistry. But the four curricula associated with the Founders' Societies were all inaugurated prior to the founding of the S.P.E.E.

After the founding of the S.P.E.E., in 1893, this period of program and curriculum development seemed to have absorbed most of the energies of the Society in just those particular aspects. If you refer to the monumental work of President Wickenden and Dean Hammond, also presented in the Survey of Engineering Education, you will find that in that period, about the middle of that period, the specialization in engineering education reached its highest point. There were many courses of application as well as of a fundamental nature that were introduced into all curricula.

In the latter part of that period, specialization began to decline but during that period we had great contributions to our fundamental courses. Some of those who contributed to the courses, wrote the textbooks which were used widely, organized the instructional material, gained renown and made great contributions in engineering education, were Professor Church of Cornell University, Maurer of Wisconsin, Talbot of Illinois (Dean Turneaure with his water supply and his book on structures), all previous winners of the Lamme award. The contributions in that period were directed toward the strengthening and development of the undergraduate courses in engineering.

Then in 1907, a long while before the end of that period which I call an era, when Dr. Jackson was head of the Society at Cleveland, a committee was organized for a study of engineering education, a critical study of engineering education. It took that committee some time to get under way and to enlist the interest of the professional societies, and their support, and also to find that the job was going to be a rather big one and they must have even more support. This they secured from the Carnegie Foundation, and the Mann report was presented as a result of that original investigation in 1918.

Now the Mann report has never had much discussion nor attracted too much attention in engineering education. This seemed to me primarily because it was more or less submerged by the first World War, because it came out just as that war came to a conclusion and there were many administrative problems and personnel problems occupying the attention of all in engineering education. But one thing which the Mann report did was to focus the attention of engineering education upon the student, upon the student as a novice in the profession. It focused the attention upon the attributes, the powers and the skills that are essential to success in engineering. That began immediately to find its reflection in pedagogy, in institutional practices, in all of the aspects of engineering education. In short, it ushered in an era of personalized education.

I would not claim that engineering education was unique in that respect, because that happened throughout all of the schools in our university system. The success of the Alpha Beta tests in World War I gave great emphasis to psychological testing. Beginning with that date, however, a series of things happened. The psychological tests were used for admission into our institutions and as a guide to admission officers in our institutions. Shortly thereafter the Board of Investigation and Coordination was appointed. Beginning its studies in 1926, and continuing its work for six years, it placed great emphasis upon the personal aspects of education as well as the subject matter and organizational aspects of education.

Then the summer schools followed, under the direction of Dean Hammond, and then our guidance programs, through the E.C.P.D. With the founding of the E.C.P.D., which was directed primarily to the enhancement of the engineering profession, the development of the personal qualities of engineers, not alone in student ranks, but in the junior ranks of practitioners, has been emphasized.

The report of aims and objectives of the engineering curricula, and finally, the report of last year on post war education followed.

You will notice all through this series that our distinguished member here this evening gave a very vigorous leadership. Most of the things that I am pointing out in this personalized era of education flourished greatly because of his guidance and his indefatigable purpose.

Now, with these three eras behind us, where do we stand today? What is the threshold from which we look forward?

It is readily apparent in the work of the Council this afternoon, in the problems of education which have confronted us today. We stand at the threshold of a new era. Not one which supplants these others, as none of the three supplanted its predecessor, but was, on the contrary, associated with it and became a part of it. So we stand on the threshold of an era in which our problems are problems of deepening our scientific education as we broaden its scope and perspective, and in which the need in our Society organization is to preserve unity for the consideration of those problems, for the consideration of the matters, which are coming before us more and more often in our relationships with Government agencies and to the public welfare.

It seems to me these are the matters which will command our greatest energies, which will command the best

vision that we can bring to their solution. These are the problems which, if we succeed in solving, will enhance and promote engineering education, but which if we fail to solve will leave us far below the level of achievement that might be ours.

I have been very much interested in bringing these facts together. It has disclosed to me something about engineering education that I had not previously observed. It gave to me some perspective for the measure of our problems today. I thought it would be worth while to present these ideas to you this evening, in the nature of an abbreviated presidential address.

The University of Pittsburgh Senate*

By RUFUS H. FITZGERALD
Chancellor, University of Pittsburgh

When Dr. Bishop asked me to say a word to you tonight, I asked him what I should talk about. He replied, "Anything but engineering." So, I shall stay away from that field.

Since you are interested in the general field of education, you might like to know something about a venture in administration which has been going on at the University of Pittsburgh during the past five years. That venture is the work of the University Senate. There is nothing new, of course, about university senates. Some institutions have had them for years. But the morale developed here in the faculty by this Senate makes it worth discussing. In fact, one member of the faculty thought so well of the work of the Senate he presented in 1944 a paper on its development and its accomplishments to the Division on Higher Education of the National Education Association.

The Senate is a democratic plan of cooperation between the faculty and the administration. A plan which enables men to take a greater responsibility for their destiny is good. That responsibility is the core of real democracy. We have talked much about the democratic process. Do we educators honestly believe in it or really practice it?

I must admit that, although I favored the senate idea, I had my fingers crossed about the success of faculty participation in administration. Would the Senate reach conclusions that were in conflict with those reached by the Administration? How much patience would it take to watch and wait? How much time would be wasted? Would the faculty speak frankly? Would we in the Administration be too sensitive to take their criticism? Would the members think objectively or would they think primarily in terms of themselves and their departments? These are some of the questions which stayed rather persistently in my mind.

Five years are not long enough to answer definitely those questions, nor should I wish to indicate that experience gives absolute assurance of smooth sailing with the Senate in the future. There is always an unpredictable element in the adventure which is democracy. But there are some results of the University's experiment for the five-year period that can be reported.

The University Senate

The Senate is made up of full-time resident professors, associate professors, and administrative officers—a total of one hundred and sixty. It functions through the Executive Committee and the following standing committees:

* Presented at a dinner meeting, S.P.E.E. members living in Pittsburgh, June 1, 1945, Schenley Hotel.

The Committee on Educational Policies
The Committee on Tenure and Academic Freedom
The Committee on Budget Policies
The Committee on Library and University Publications
The Committee on Public Relations
The Committee on Student Relations
The Committee on Elections

There are three or more meetings of the full Senate each year, when standing committees and special committees make reports and present resolutions.

The Executive Committee meets every two weeks. Its agenda has included many of the problems that are also on the agenda of the Board of Deans. It is significant that up to this time, through objective discussion in their respective meetings, the Executive Committee, composed of members of the faculty, and the Board of Deans have reached approximately the same conclusions on every major item.

The Educational Policies Committee

In its 1943 report the Educational Policies Committee reported on several topics: enrollment trends in the postwar period; the general classifications of those returning to college after the war; the problem of educating the 50 per cent who graduate from high school and who for financial reasons do not go to college. This committee also raised several questions: whether our present arrangement of curricular experience is adequate to meet the needs of students of ordinary ability and of students more gifted; what particular adjustments, if any, will have to be made in the present program; and the desirability of formulating a distinctive program for both the average student and the gifted student.

This report called for a rigorous evaluation by the Administration of the present program of general education.

In other reports this same Committee summed up its thinking this way: "We must not, in the postwar era, commit the blunder of turning loose upon society technological experts who have little sense of the place of technology in society, specialists who are lacking in social intelligence required to find ways of socializing our skills. It would appear that studies of the major cultures of the whole world and not merely of western civilization should have a place in the program of general education. Institutions of higher learning must examine their responsibilities for postwar adult education."

Always the Committee on Educational Policies has emphasized the importance of research and stressed the necessity of broadening research to all fields.

It has favored "an effective counseling service . . . to assist war veterans in their adjustment to intellectual study."

During this school year the Committee has been working on the reorganization of the Graduate School. It recommended to the January meeting of the Senate that three committees be appointed to consider the organization and policies of the Graduate School: (1) a Committee on the Humanities, (2) a Committee on the Sciences, (3) a Committee on the Social Sciences. These committees now are organized and are studying the relationship of the work of the undergraduate, the professional, and graduate areas in the Humanities, Sciences, and Social Sciences and will submit their three reports to the Educational

Policies Committee so that they can be properly coordinated for submission to the Senate.

The subjects they are considering are:

1. The existing organization of the Graduate School and recommendations with respect to the improvement of its organization. The relationship between the Dean of the Graduate School and the Undergraduate Deans who control the budgets in the departments where members teach in the Graduate School.

2. The present method of establishing courses carrying graduate credit and changes in procedure if changes are found desirable.

3. The present method of assigning teachers for courses carrying graduate credit. Who decides this: The Dean of the Graduate School, the Undergraduate Dean, the Head of the Department, or the teacher of the course? What procedure should be established if the present method seems unsatisfactory?

4. The present relationship of graduate and research work at the University to the special needs of the community. How could our graduate work be articulated more successfully with community needs?

5. The present facilities of the several departments with special reference to teachers in the Humanities, the Sciences, and the Social Sciences and expansion or contraction as seems desirable.

6. The proper relationship between the Graduate School and the professional schools. Should this relationship be uniform for all professional schools?

7. The relationship between graduate and undergraduate work in the University and any changes that may be found desirable in the existing relationship.

I have gone somewhat into detail about the work of the Educational Policies Committee, believing that, as an example, the workings of one committee would give you a better picture of the Senate than a brief survey of all committees. I now wish to mention a few significant things that have been accomplished with the help of other committees.

Committee on Tenure and Academic Freedom

The Committee on Tenure and Academic Freedom helped to work out a plan of tenure that was approved by the unanimous vote of the Board of Trustees and the Senate in March 1944.

Committee on Library and University Publications

The Library and University Publications Committee has been influential in improving the physical facilities of the library, facilitating the *use* of the library, changing operating policies, centralizing resources, establishing new divisions, determining the adequacy of the library from the standpoint of our needs.

The study of this committee showed some glaring deficiencies in certain graduate fields. Their report on current and future problems was especially significant. It dealt with such things as: space, centralization, expenditures, microfilms and microprints, regional and national agreements as to broad and special fields to be covered by each library, and the like. The chairman of this committee, a young professor of chemistry, did his work so thoroughly that he is now Acting Librarian.

The Budget Policies Committee

The Budget Policies Committee was a great help in working out many financial problems during the period of war training and acceleration.

THE VALUE OF THE SENATE

The work of the Senate for the five-year period can be summarized as follows:

1. There has been no slackening of faculty interest. The attendance record shows that.
2. Most of the committees have worked hard.
3. There has been no serious conflict between the conclusions of the Senate and the conclusions of the Administration.
4. Although the work has taken considerable time, that time has not been wasted.
5. Faculty members have spoken very frankly in committee meetings.
6. Faculty men have put the welfare of the University above that of themselves and their departments.
7. The Senate has given the faculty man a sense of belonging.
8. It has helped the University accomplish things that would not have been possible without it.
9. It has brought about a new morale. Let me quote from the paper of the professor who addressed the National Education Association:

Placed first on the list of accomplishments is the development of a new loyalty and a feeling of belonging to the University in and among the several faculties of the University staff. Our mutual problems are studied scientifically and thought through carefully by the appropriate committees. When a problem is presented on the floor of the Senate, there is the opportunity for the give-and-take of free debate. As one member expressed it, the spirit of the best wisdom must prevail. While some members are still hesitant to accept the challenge of debate, time no doubt will bring about a marked improvement in this respect. Care is taken to prevent undue action leading to unwise recommendations. Having once made up its mind, however, the Senate has been fearless in its recommendations. Within so short a period of time, many of its recommendations have been put into practice.

The several faculties have become informed as never before concerning the policies of the administration, and concerning information of University interest heretofore not available, perhaps because heretofore there was no appropriate means to make it available. Especially has this been of mutual advantage during the past two years when the armed services training programs required the closest possible cooperation between administration and faculty. The Senate has become a clearing house for many administrative and instructional problems which arose simultaneously with the development of that program. These are but a few earmarks of a stepped-up staff morale.

The Senate has been good to date because it has provided a democratic plan which enables men to take a greater responsibility for their own welfare and destiny.

Report of Secretary, F. L. Bishop, 1944-45

The 1945 Meeting.—The order, issued by the Office of Defense Transportation, limiting travel to meetings to 50 persons led the Executive Committee, at a meeting in Pittsburgh February 4, 1945, to consider this matter carefully. The Committee voted unanimously to recommend to the Council that the 1945 meeting scheduled for St. Louis, June 21–24, be postponed. This recommendation was sent to the Council and the vote was 49 for cancellation of meeting, one opposed, and one not voting.

The Executive Committee deemed it advisable to call a meeting of the Council to transact such business of the Society as would come before it. A letter was sent to all members of the Council to determine the best dates and place for the meeting. An analysis of the replies indicated that Pittsburgh should be the meeting place and June 1 and 2 the only open dates. Thirty-five members of the Council of 51 indicated their intention of attending the meeting.

Membership.—There have been 27 deaths, 54 dropped for non-payment of dues, and 90 resignations. We have elected 263 new members this year. The total membership is 3,787 individual and 162 institutional members, making a grand total of 3,954.

Publications.—This Society, in common with all other organizations, has had trouble with the printing of its publications. These difficulties, as is well known, arose from two factors, one, the shortage of paper, and two, the shortage of manpower in the printing establishments. This combination has led to the uncertainty of publication of THE JOURNAL OF ENGINEERING EDUCATION.

There is another interesting matter in connection with the JOURNAL which has to do with the papers presented for publication. For a number of years we have had several times the number of papers submitted that we could use. With the cancellation of the 1945 meeting, we shall be short of papers which are suitable for publication. We have been in contact with the chairmen of divisions and committees who had planned conferences for the St. Louis meeting and they are securing papers for us.

The February JOURNAL is the year book of the Society. A modification in the ruling of the Post Office Department some years ago necessitated that we have at least one article in this issue. This year President Rogers wrote an excellent article on the Highlights of the History of the Society for the Promotion of Engineering Education.

The report of your Committee on Engineering Education After the War was published in the May 1944 JOURNAL. We have distributed a very large number of reprints not only to engineering educators but to educators in other fields.

A study of much interest is the report of the Committee on Graduate Study under the chairmanship of L. E. Grinter. This is a comprehensive study and will be published in the June JOURNAL and reprints in the form of a manual will be available for distribution shortly thereafter.

Ten thousand leaflets describing the aims and organization of the Society

were printed and distributed to the entire engineering mailing list of the McGraw-Hill Book Company.

A question which has been raised many times is a comprehensive index of the Society's publications. The last index was the twenty-year index. I believe this should be brought up to date and an index from Volume I to June 1945 be prepared and published. I strongly recommend that this be included in the budget for 1945–46.

Divisions.—The Division on Humanistic-Social Studies, H. P. Hammond, Chairman, is an outgrowth of the report on engineering education after the war. The Executive Committee of this Division recommended to the Executive Committee of the Society that the sum of $500 be appropriated to help defray the traveling expenses of two men to study the development of the humanistic-social group in various institutions. This request was approved and Professors R. M. Boarts and J. C. Hodges of the University of Tennessee were selected. The University of Tennessee joined with the Society in paying the expenses of these men. A report of their study will be printed in the JOURNAL next fall.

The excellent work of the Division of Administrative Officers of Engineering Colleges, under the chairmanship of A. A. Potter, will be covered in a report by President Potter at this meeting.

The Division on Civil Engineering appointed a committee to cooperate with a committee from the American Society of Civil Engineers in a study. The Executive Committee of this Society authorized the appropriation of $300 for the use of this Committee.

The Division on Educational Methods, under the chairmanship of R. H. Frazier, was authorized last June. It has been at work this year getting the Division well organized.

The Division on Drawing and Descriptive Geometry, under the chairmanship of Justus Rising, planned to have a summer school immediately following the St. Louis meeting. However, when our plans were cancelled this meeting also was cancelled for 1945. If travel permits, the summer school will be held in 1946.

Committees.—The Committee on Revision of the Constitution and By-Laws was authorized by the Council last June. The committee has sixteen members under the chairmanship of H. S. Rogers. A drafting committee of six members was appointed within this committee, Robert E. Doherty, Chairman. The larger committee met in Chicago last October and the drafting committee has held two meetings, in Pittsburgh, one in February and one at this meeting. At both of these meetings, representatives from the Engineering College Research Association were present. The results of these meetings have been sent to the Council and will be considered at this meeting.

Sections and Branches.—The same regulation which prevented the annual meeting from being held in St. Louis has affected the holding of sectional meetings.

Closure.—In closing this report, I want to pay homage to Charles Felton Scott, the only individual who was elected President of this Society twice; who created the committee and secured the funds for the investigation of engineering education; who contributed continuously up to the very time of his death to the betterment of his coworkers and of engineering education in general—a gentleman, a scholar, and our friend.

Report of the Treasurer, 1944–45 *

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION
COMPARATIVE STATEMENT OF CASH ACCOUNT

May 22, 1945

	1943–44 (June 10, 1944)	1944–45 (May 22, 1945)
BALANCE ON HAND:		
Forbes National Bank—Checking Account	$ 9,053.19	$14,161.74
Forbes National Bank—Savings Account	536.63	636.07
Total Balance	$ 9,589.82	$14,797.81
RECEIPTS:		
Current Dues	$16,786.30	$16,912.24
Back Dues	2,305.25	1,891.50
Dues in Advance	247.50	235.00
Sales of Publications	745.93	832.36
Advertising	3,820.47	3,703.93
Sale of Emblems	242.05	47.25
Interest on Savings Account	5.69	3.18
Interest on Government Bonds	187.50	218.75
Gift from Carnegie Foundation for Committee on Engineering Education after War	1,500.00	—
Gift from Rockefeller Foundation for Conference on Social Humanities Problems	1,800.00	—
Total Receipts	$27,640.69	$23,844.21
DISBURSEMENTS:		
Cost of Publications	$ 8,809.28	$ 8,649.45
Honorarium for Secretary	2,000.00	2,000.00
Clerical Assistance	4,000.00	4,225.00
Travel and Entertainment—Secretary's Office	429.15	231.90
Committee Expenses	35.76	—
Officers' Traveling Expenses	105.39	66.34
Printing, Postage, Office Supplies, etc.	1,500.19	1,352.27
Expenses—1943 Meeting	297.80	—
Expenses—1944 Meeting	391.58	680.98
Expenses—1945 Meeting	—	59.17
Dues—American Council on Education	100.00	100.00
Contribution to Engineers' Council for Professional Development	750.00	250.00
Expenses—Division of Mechanics	21.15	—
Expenses—Administrators' Division	178.58	870.43
Expenses—Army Specialized Training Program	908.95	—
Expenses—Committee on Engineering Education after War	1,714.15	315.16
Expenses—Civil Engineering Division	—	186.88
Expenses—Committee on Credits	100.57	—
Expenses—Conference on Humanistic Social Problems	29.00	172.02
Expenses—Physics Division	—	9.44
Expenses—Committee on Graduate Studies	—	209.19
Expenses—Revision of Constitution	—	637.47
Disbursement for Purchase of Series "G" Government Bonds	—	2,500.00
Contribution to Measurement and Guidance Project	300.00	—
Disbursement for Lamme Award	191.49	—
Purchase of Emblems	569.66	—
Refund of Gift from Rockefeller Foundation	—	1,800.00
Advance to University of Tennessee Humanistic-Social Studies Division	—	460.00
Total Disbursements	$22,432.70	$24,775.70

* Audited by H. E. Daer.

BALANCE ON HAND:		
Forbes National Bank—Checking Account	$14,161.74	$13,227.07
Forbes National Bank—Savings Account	636.07	639.25
Total Balance on Hand	$14,797.81	$13,866.32

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION
COMPARATIVE BALANCE SHEET

As of June 30, 1944 and 1945

ASSETS

	1944 (June 10, 1944)	1945 (May 22, 1945)
Cash:		
Current Fund	$14,161.74	$13,227.07
Petty Cash Fund	300.00	300.00
Life Membership Fund	915.83	931.91
Savings Account	636.07	639.25
Total Cash	$16,013.64	$15,098.23
Securities:		
United States Government Bonds—Series "G"	$ 7,500.00	$10,000.00
Benj. G. Lamme Trust Fund:		
Securities and Mortgages	$ 4,866.88	$ 5,056.00
Uninvested Cash	249.25	88.25
Checking Account	112.77	263.71
Total Lamme Fund	$ 5,228.90	$ 5,407.96
Prepaid Expenses: 1944 Meeting (1945)	$ 391.58	$ 59.17
Inventory (Nominal)	1.00	1.00
Accounts Receivable:		
Advertising	1,000.00	1,100.00
Dues	1,000.00	1,000.00
Benj. G. Lamme Award	191.49	191.49
Advance to Universiry of Tennessee for Humanities Social Studies Division	—	460.00
Furniture and Fixtures (Nominal)	100.00	100.00
Total Assets	$31,426.61	$33,417.85

LIABILITIES

Life Membership Fund	$ 915.83	$ 931.91
Benj. G. Lamme Trust Fund	5,228.90	5,407.96
Prepaid Membership Dues	247.50	235.00
Accounts Payable	1,300.00	2,200.00
Gifts by Rockefeller Foundation	1,771.00	—
Total Liabilities	$ 9,463.23	$ 8,774.87

SURPLUS ACCOUNT

Balance	$18,275.33	$21,963.38
Surplus for Year	3,688.05	2,679.60
Total Surplus	$21,963.38	$24,642.98
Total Liabilities and Surplus	$31,426.61	$33,417.85

Society for the Promotion of Engineering Education
Comparative Statement of Income and Expense
For the Years Ending June 30, 1944 and 1945

	1943–44 (June 10, 1944)	1944–45 (May 22, 1945)
Income:		
Current Dues	$18,313.80	$18,159.74
Back Dues	1,405.25	891.50
Sales of Publications	745.93	832.36
Advertising	3,829.47	3,803.93
Sales of Emblems	242.05	47.25
Interest on Savings Account	5.69	3.18
Interest on Government Bonds	187.50	218.75
Gift from Carnegie Corporation (used)	1,500.00	—
Gift from Rockefeller Foundation (used)	29.00	—
Total Income	$26,258.69	$23,956.71
Expense:		
Cost of Publications	$ 9,309.28	$ 9,549.45
Expenses—1943 Meeting (1944)	518.81	1,072.56
Honorarium for Secretary	2,000.00	2,000.00
Clerical Assistance	4,000.00	4,225.00
Printing, Postage, Office Supplies, etc.	1,500.19	1,381.27
Travel and Entertainment—Secretary's Office	429.15	231.90
Committee Expenses	35.76	—
Officers' Traveling Expenses	105.39	66.34
Dues—American Council on Education	100.00	100.00
Contribution to Engineers' Council for Professional Development	750.00	250.00
Expenses—Division of Mechanics	21.15	—
Expenses—Administrators' Division	178.58	870.43
Expenses—Army Specialized Training Program	908.95	—
Expenses—Committee on Credits	100.57	—
Expenses—Committee on Engineering Education after War	1,714.15	315.16
Expenses—Conference on Social Humanities' Problems	29.00	172.02
Expenses—Physics Division	—	9.44
Expenses—Committee on Graduate Studies	—	209.19
Expenses—Committee on Revision of Constitution	—	637.47
Expenses—Civil Engineering Division	—	186.88
Cost of Emblems	569.66	—
Contribution to Measurement and Guidance Project	300.00	—
Total Expense	$22,570.64	$21,277.11
Surplus for the Year	3,688.05	2,679.60
Total	$26,258.69	$23,956.71

Annual Report of Division of Administrative Officers of Engineering Colleges

This was presented to the S.P.E.E. Council at Pittsburgh, Pennsylvania, on June 1 and June 2, 1945 and covered the following matters:

(a) *Critical Shortage of Graduate Engineers.*—After contacts with the American Council on Education, the National Roster, the Office of Scientific Personnel of the National Research Council, and Selective Service, the Chairman of the Division made a study of the critical shortage of engineers in American industry. The results of the study were reported in the JOURNAL OF ENGINEERING EDUCATION for April, 1945. This survey indicated a critical shortage of 4,590 engineers for 105 companies. These data were projected by the Office of Scientific Personnel of the National Research Council to include all industry, and it is apparent that there is at the present time a shortage of at least 40,000 engineers in this country.

(b) *Revision of Selective Service.*—A Committee of the Division on Selective Service, under the Chairmanship of A. B. Newman, has aided the American Council on Education and agencies of the Government in giving consideration to a modification in Selective Service Regulations to insure a practical flow of at least minimum quotas of engineers and scientists.

(c) *Universal Military Training.*—Special consideration has been given to Universal Military Training by a committee of the Division, under the chairmanship of S. C. Hollister. Conferences were held with major representatives of the armed forces for the purpose of aiding the Government in developing a plan for national security, which will be completely democratic, acceptable to the people in time of peace, and which will make maximum use of science and technology.

(d) *Army Educational Program.*—Several conferences were held and considerable correspondence was exchanged with the War Department regarding an educational program to further the preparation for civilian life of those in the Army of Occupation or awaiting shipment home from Europe.

(e) *Cooperation with Naval Academy.*—Conferences were held at Annapolis, Maryland, with reference to cooperation between the engineering colleges and the Postgraduate School of the Naval Academy.

(f) *U. S. Civil Service Commission.*—The Division has cooperated with the U. S. Civil Service Commission in setting up a committee of career engineers and scientists for the purpose of aiding the Commission in insuring suitable standards for scientific and engineering positions of the Government.

(g) *Federal Aid to Research.*—In cooperation with the E.C.R.A., the Division has maintained contact with agencies interested in promoting Federal aid to engineering and scientific research.

(h) *Committee on Academic Ten-*

ure, Professional Service, and Responsibilities.—A committee on Academic Tenure, Professional Service, and Responsibilities, under the Chairmanship of C. J. Freund, has been studying engineering staff salaries, tenure, professional practice, and other matters which differentiate engineering teachers from the other academic staffs. A report of progress was presented at the meeting of the Council on June 2, 1945, and this will be published in the JOURNAL OF ENGINEERING EDUCATION.

SURPLUS GOVERNMENT PROPERTY

The Vice-Chairman of the Division, Dean Steinberg, as the Special Representative of the Society, has kept in close contact with Surplus Government Property matters and with the procurement regulations of the Army Service Forces.

Enclosed is a copy of a letter which was mailed on April 7, 1945, by the United States Commissioner of Education to the Chief State School Officers advising them to secure the cooperation of all types of educational groups in matters related to government surplus property. Regulation 4, mentioned in the attached letter, was mailed by Mr. Harold E. Sweeney of Bendix to the Presidents of all universities and colleges. It will be to the advantage of your institution to contact your Chief State School Officer regarding the enclosed letter by Dr. Studebaker.

Dean Steinberg has informed me that in a conference with Mr. R. A. Heddleston of the Surplus War Aircraft Division, who will have charge of the disposal of aeronautical equipment under regulation 4, he was advised that in about two weeks all universities and colleges will receive detailed information on applications for securing this property.

S. C. Hollister of Cornell University succeeds A. A. Potter of Purdue University as Chairman of this Division, effective July 1, 1945.

For the Executive Committee of the Administrative Division I take this opportunity to thank the Principal Administrative Officers of engineering colleges for the cooperation received during the past fiscal year.

Cordially yours,

A. A. POTTER,
Chairman

FEDERAL SECURITY AGENCY

U. S. OFFICE OF EDUCATION

WASHINGTON 25, D. C.

April 7, 1945

MEMORANDUM

TO: CHIEF STATE SCHOOL OFFICERS
FROM: J. W. Studebaker, U. S. Commissioner of Education
SUBJECT: Disposal of Surplus Property to Educational Institutions

On several occasions I have discussed with the Surplus Property Board and members of its staff problems involved in the disposal of surplus property to educational institutions eligible under the provisions of the Surplus Property Act of 1944. Following a conference with the Hon. Robert A. Hurley of the Surplus Property Board, he recently wrote me to make a matter of record certain views of the Board. He stated:

"You realize, of course, that the Board must find solution to the many questions arising in connection with its effort to recognize the various priority and preference provisions of the Act. As it formulates policies and develops plans for the program of disposal, it is clear that the Board must have the advice and assistance of the many interested groups of potential buyers, includ-

ing educational institutions eligible under the provisions of Section 13 of the Act.

"We are of the opinion that some means of cooperative action of these educational institutions within each State will be invaluable for example in compiling and making available, on a State-wide basis, recommendations about needs of surplus property for effective educational use and in making known at the appropriate time the educational requirements to the designated disposal agencies.

"Although the Board has, of course, no intention of suggesting or prescribing how such cooperative action can be provided, it would seem obvious that any mechanism in a State which will make possible such cooperative action on a State-wide basis will serve a continuously useful function in relation to the disposal of surplus property to educational institutions."

Any such mechanism would, as indicated above, be effectively helpful to the extent that it would serve as a means of securing cooperative action, on a State-wide basis, of tax-supported and other non-profit educational institutions eligible under the provisions of Section 13 of the Act. The need for some mechanism within each State to permit all such eligible educational institutions to participate effectively in the surplus property program has been emphasized in several conference and committee reports. The Office of Education Advisory Committee on Surplus Property recognized this principle in formulating its report of recommendations which I transmitted to the Board in December 1944. A digest of this Committee report and of a supplement recently prepared by a small working committee of the Advisory Committee will appear in an early issue of *Education for Victory*. A mimeographed copy of this digest was sent to you under date of March 20, 1945.

It is suggested that the regularly-constituted educational authorities of the States take the leadership in discussing and considering this problem with a view of securing cooperative action of all eligible educational institutions on a State-wide basis.

The Office of Education and the Advisory Committee on Surplus Property are anxious and willing to be of every possible assistance in the consideration of this problem.

/s/ J. W. STUDEBAKER,
Commissioner

Inspection Practices and Procedures in Their Relation to Mechanical Engineering*

By ROLLAND JENKINS

Sperry Gyroscope Co., Brooklyn, N. Y.

The organization of the manufacturing division of a plant in a sense resembles that under which our republican form of government was intended to operate. In government we have three main functions—legislative, executive, and judicial. In the shop we have engineering or the legislative function, production or the executive function, and inspection or the judicial function.

The engineer designs the product and all of its detail parts, determines the materials to be used and selects the dimensions, tolerances and fits of the individual parts. All of this he sets forth in mechanical drawings, copies of which, in the form of blueprints, are passed on to the production and inspection departments to serve as their rule and guide, and from that time the blue-print becomes their sole authority as to what they should produce. Thus, in effect, the engineering department legislates as to the performance of everyone concerned in the production of manufactured goods.

How to produce is the responsibility of the manufacturing department. Manufacturing engineers, or methods men as they are sometimes called, study the blue-prints, and having in mind the machines and equipment available, the quantities required and economy of cost, they outline in full detail the sequence of processing. This so-called operation sheet contains minute instructions for operators and itineraries for internal transportation, from the receipt of the raw stock or casting to the final processing where the part is assembled or placed in the stockroom. Thus the production department acts as the executive division, to carry out the instructions of the engineer.

But, just as in many other activities of life, frequent checks and controls are needed to ascertain whether the legislative acts are being executed in accordance with all the original intent and purpose. Here is where a group of referees or judges is needed, and that is known as the inspection department.

Before the days of mass production or interchangeable manufacture, every machinist was his own inspector. Close tolerances were not so frequently specified or required. Component parts were selectively assembled or fitted to each other.

Interchangeable manufacture, however, made it necessary to impose dimensional limits so that mating parts would assemble with reasonable ease

* Presented at the 52nd annual meeting, S.P.E.E. (Mechanical), Cincinnati, June 22–25, 1944.

and accuracy, and so that spare parts that would fit could be supplied to distant customers. Inspection of mechanical parts began to be practiced in the larger plants. At first inspection was confined to dimensional measurements only, but even so it was considered by management to be a necessary evil, and by production as somewhat of a nuisance.

Like insurance, inspection is an expense that must be justified by the need for it, and with the advent of mass production it very soon became apparent that control of quality was not only desirable but it was an essential factor in manufacture.

Between the design of a given piece of work and its ultimate completion there is ample opportunity for honest and justifiable differences of opinion as to permissible variations from an ideal standard. The designer will naturally specify limits as close as possible to the basic dimensions. The manufacturing department, knowing that precision is costly and somewhat difficult to attain, is always pulling away from close tolerances. Quality or lack of it, must necessarily be worked into a product and the responsibility for production of standard quality rests on those who produce. Inspection measures the degree of achievement and thereby acts to check any trend toward hasty or inferior work, which would bring about a deterioration of quality all along the line.

However, inspection goes a good deal beyond measurement in a physical sense; it adds judgment to measurement. In its fullest sense inspection should not only find or detect imperfect work but should prevent it. There are five points in the manufacturing cycle where inspection may serve to prevent sub-standard production.

First, at the point where raw materials are received, metallurgical tests for physical qualities of raw stock, X-ray and visual examination of castings for blow-holes and other defects, all serve to screen out a certain amount of material from further processing.

Second, checking of the first piece produced at the beginning of an operation, to guard against improper set-up or defective workmanship, and periodic inspection thereafter to assure continued production of acceptable work, and to prevent spoilage due to wear or dulling of tools, or inadvertent changes in machine settings. Such inspection, carried out at suitable stages in the stream of production brings to light instantly variation in efficiency of equipment or operator. This is known as "floating inspection" and has proved of inestimable value in forestalling the waste of defective parts.

Third, the checking of lots or units of semi-finished parts so that any defective pieces may be scrapped or reworked. In this way the expense of subsequent operations on a part already unsuitable, is avoided.

Fourth, at assembly where imperfect parts which may have gotten by previous inspection or which have become damaged in transfer, can be spotted before they cause dismantling or repair of the product.

Fifth, the final inspection or test to determine the functioning, under conditions usually more severe than those for which the product was designed.

In addition to all of this, inspection is charged with the responsibility of maintaining the serviceability and accuracy of the small measuring tools, not only of the inspectors but the machine operators as well; also the inception of the special gages that are

so necessary in repetitive machine work, to simplify and facilitate checking of the myriads of small parts that make up small instruments and intricate mechanisms.

For example a flight instrument containing 200 component parts may require upwards of 1,000 special gages for efficient checking in the various stages of manufacture.

There is much more that might be mentioned as coming within the scope of the inspection department, but it is apparent from what has been briefly outlined that inspection has grown up and has attained an important responsibility in the manufacturing organization.

There is no settled practice today as to the status of the inspection department in the organization. In some plants it is a function of the manufacturing division, in others it is controlled by the chief engineer and in still others by the sales department. Whatever the practice in any individual plant there are perhaps sound reasons for it, as problems of manufacture differ almost as widely as the types of products. But it is beginning to be recognized that inspection should have an independent status free from the influence of any departmental viewpoint. For instance where inspection is subordinate to manufacturing, poor methods and workmanship might be covered up. If subordinate to engineering, errors or defects of design might be concealed as they become apparent.

On the other hand inspection has a degree of authority over other departments, such as the stopping of machines from which faulty work is coming, the rejection of sub-standard raw materials, etc. It is therefore becoming more and more apparent that the principle of setting up and operating the inspection department as an independent function is sound from almost any angle.

Mention has already been made of the tendency of engineering to specify close tolerances, and for manufacturing to draw away from these close limits. Between these two there is need for compromise under expert guidance and an impartial inspection department is qualified to provide this advice and assistance. In addition, close collaboration between product engineers, inspectors and manufacturing engineers encourages an interchange of ideas with a view not only to the maintenance of standards of quality and production of quantity, but an improvement in both directions. We should also not disregard the possibilities of suggestions from experienced men other than engineers that might result in engineering changes to cut production costs.

The most obvious common ground for collaboration between the departments just mentioned is the selection of dimensions, tolerances and fits. These relationships affect the facility with which a shop can produce acceptable parts, they influence the kind and degree of gaging and cost of manufacture, and they are essential to the proper functioning and life of the product. The engineer should be sure of the method of dimensioning best suited to the processing, the inherent accuracy of the processes to be used, and the most convenient and efficient method of gaging.

It is not uncommon for parts to reach the inspection department with blue-print specifications that cannot possibly be checked by any conventional method. Weeks of study may be necessary to determine a way of

checking and then several months may be required to construct special gaging devices. If the inspection and methods men had been consulted at the inception of the idea, ways might have been found to modify the design to existing gaging methods or at least to permit sufficient time to provide suitable gages before the part was in production.

Despite all efforts to produce standard parts, there are always quantities of questionable parts with which to deal. The obvious and immediate objective is to salvage these parts by making them usable. More important, however, is the opportunity afforded to study the reasons why these parts are not acceptable and thereby apply corrective measures to prevent a continuance of the practices or inferior workmanship that are responsible for sub-standard parts.

One approach to this problem is the formation of a small group which might be called the "Conservation Committee." This committee would logically consist of key representatives of the three main departments—the engineer in charge of the product, the manufacturing engineer who controls the methods of processing, and the chief inspector. In some instances it might be desirable to have additional committee members from other departments, such as assembly or test.

All parts questioned for any reason, or representative samples thereof, are submitted to this committee. After determining whether the part may be saved by reworking, repair or special treatment, the committee analyzes the causes of the defect and decides what steps must be taken to prevent or minimize the trouble in the future.

Obviously, to such a committee must be delegated authority to cut through the red tape of any shop practice that might ordinarily incur unreasonable time lapses before their decisions could take effect. This may be accomplished by having their action implemented at once by the issuance of temporary operation or rework instructions by a representative of the manufacturing engineer, re-routing of questioned parts by a production control man, and initiation by the engineer of any necessary blue-print changes.

The major problem encountered in the operation of machine shops during the past two or three years, has been the gradual deterioration in quality and lessening of percapita production due to personnel problems. The continued demands of the armed forces and the multiplication of machine operators have brought about a situation where debutantes and beauticians, housewives and stenographers, brokers and salesmen are being employed to perform the functions of the old-time machinist.

In most cases their training is brief and perfunctory. As an illustration, I recall visiting a shop some months ago, and noting that two women were assigned to each lathe, I asked the foreman the reason for this. He said that one young lady was being instructed to operate the machine by the other, who in turn I was informed was an "old timer," having been working at a lathe for an entire week!

When we consider that it usually requires a four-year apprenticeship for a mechanically-minded young man to become a really competent machinist, it is readily apparent that we must either lower our standards or install automatic machines, or both, and then cast about for additional ways of producing acceptable mechanical parts.

Nevertheless it has been quite sur-

prising how readily some of these people, without any mechanical background, have taken to their new trade. It was recognized even before the emergency that women were well adapted to many types of inspection because of their dexterity, sensitive touch and the orderly cleanliness which characterizes good housekeepers.

During 1942–43 many plants increased their operating personnel tenfold or more. As a result of the urgent need for inspectors, training courses were offered by commercial trade schools and vocational schools, and even some well-equipped technical schools and colleges provided laboratory courses. The programs with few exceptions showed little or no intelligent planning and were badly balanced. Where fees were involved they were usually exorbitant. For example, a twelve-day inspection course at $125 devoted ten of the twelve days to the theory and practice of filing, soldering and sheet metal forming, and the essential tools of an inspector such as micrometers and vernier instruments were merely exhibited by the instructor when he explained how to read the scales correctly.

The longer courses under more competent instruction were quite thorough, in fact too much so along certain lines. We had applicants from these classes who knew the theory of screw threads but had never seen or handled a plug gage. They were well advanced in plane trigonometry but could not interpret a three-view blue-print.

In the meantime many plants, believing that learning is best achieved by doing, were setting up their own training classes. They thus accomplished several important objectives. First, they could limit the course content to the specific needs of the type of inspection in which the trainee was to be engaged; second, by interspersing classroom training with actual shop experience the instruction was much more readily assimilated; third, more advanced instruction could be given as the trainee became proficient. In this way the training was tailored to the individual needs of the inspector. Thus it was possible for many trainees to progress within about a year, from elementary inspection to tool inspection, which represents the most advanced type of work an inspector is ordinarily called upon to do.

Several grades of inspection are needed in the average plant but much of the work requires no mechanical skill. A good deal of it is visual, for instance the checking of fine machine finishes for blemishes, and the microscopic examination of ball bearings for defects. In the unskilled category also is the dimensional checking of small parts with fixed and automatic gages, the testing of electrical circuits, and so on.

In all such work the leader or supervisor explains what the inspector should look for and where necessary he adjusts the instruments to the required setting. No training, skill or specialized knowledge is required. All that is needed is ability to concentrate on repetitious and sometimes monotonous work.

Another type of inspection that requires little skill is the checking of assembled instruments or mechanisms. This is also largely visual, but needs in addition a delicate sense of touch to determine the degree of play in moving parts, backlash of gears, freedom of movement, and so on.

The unskilled inspector may represent more than 50 per cent of the entire inspection personnel in plants

producing instruments or small mechanisms.

Going on to the next grade of inspection, the requirements are skill in the use of micrometers and vernier instruments, as well as the various fixed gages, and ability to interpret the simpler blue-prints. At this point classroom instruction is desirable. The most important single subject for study, both elementary and advanced, is the blue-print. Ignoring the infrequent errors in mechanical drawings, the blue-print is the Bible or the court of last resort for the inspector. He gets his yes or no there.

While on the subject I would like to emphasize the importance of one phase of blue-print study, and that is visualization. The ability to visualize the finished part from a study of the drawing can be imparted through simple methods at the very beginning, and it is of incalculable value as the drawings become more and more complex.

In the Sperry plants on Long Island, classroom instruction has been provided for about 1,500 inspection trainees during 1942–43. After careful analysis the course was standardized at about 50 hours of classroom study and practice. Classes were limited to 10 members for each instructor, in order to allow close observation of individuals and permit personal assistance to those who did not readily comprehend the problems or were slow in acquiring the various techniques. Sufficient tools and equipment were available so that students had ample opportunity to work with every type of standard tool.

During the two-year period three systems of class attendance were practiced. At first the classes met in two-hour sessions, two days weekly over the three-month period, which gave 52 two hours in class. During the balance of the week the students were engaged in production inspection in the shop.

Then as pressure of shop work became greater the overall period was shortened to two weeks with classes meeting on alternate days for eight or nine-hour sessions. Finally, classes were held for six consecutive full days. Under each of these three methods a total of approximately 50 hours of instruction was provided.

If I were asked which of the three methods gave the best long-range results I would be unable to give a conclusive answer, because there was a high rate of turnover due to military service, scattering of students to various branch plants after training, and domestic reasons. In the early months of the training school instructors were able to maintain continuous contact with the students at work in the shop, over a period of many months, but later on this was entirely impractical for the reasons just mentioned. And, in view of all the obstacles and difficulties, and the need for streamlining and cutting corners all along the line, we believe there is every reason to be proud of the accomplishment.

Senior Seminar Course at the University of Illinois

By E. A. REID

Associate Professor of Electrical Engineering

For many years all senior students in electrical engineering at the University of Illinois have been required to take a one credit hour course known as Seminar. The purpose of this course is to train the student in methods of obtaining and preparing information in written form for presentation to his fellow engineers. While some emphasis was placed on good delivery, there was no attempt to teach public speaking.

In an endeavor to make the course as valuable as possible, instructors in charge have experimented with various methods of conducting the course. In recent years, the procedure has been to divide the class into small enough groups so that each member could give two talks per semester, one on a technical and one on a non-technical subject. These talks were limited to about fifteen minutes and two were delivered at each hour period. This allowed about ten minutes discussion time for each paper.

Since the course carries one hour credit, the student could be expected to do not more than thirty-two hours outside work per semester. As this is only sixteen hours per paper, it was not felt that he could be asked to prepare two formal written papers, hence an outline and list of references only were required in written form and the talk was given from the outline and such notes as the student made.

The writer felt that this system necessarily led to rather superficial preparation. For the past year therefore, one paper of a technical nature per semester has been required, and this paper had to be submitted in written form. It was hoped that some papers would consist of the working out of a problem original to the student. This might be based on experimental work, some experience in industrial work, or an analytical solution of some problem suggested in the classroom. Under the present accelerated program and with classes made up largely of V–12 students, it was realized that there would be little opportunity for papers based on anything but library research. It was thought that a good job of this with results well written would be preferable to more talks based on less preparation. Since the A.I.E.E. should be one of the chief mediums for the publication of the graduate engineer's work, an effort was made to have the papers conform to the requirements of that society. Each student was furnished with a copy of the Institute's pamphlet "Information for Authors" and asked to use it as a guide in the preparation of the paper.

With the same thought in mind, a grading sheet was prepared, using the basis for grading of Branch papers given in the Institute's pamphlet on Prizes. No changes were made in

these rules except to alter the weighting slightly in order to give some weight (30 per cent) to the oral presentation. This was divided into three sections, namely, Bearing, Diction, and Delivery. The complete grading sheet is shown in Table I. These were handed out to each student at each session, and the speaker was graded by every student in the class. The purpose of this student grading was to develop the ability to analyze and criticize the work of others and thus help improve their own work. An interesting and somewhat unexpected result was the almost exact agreement of the average of the student grades with that of the instructor.

As an additional small incentive, a group of the best papers, selected on the basis of the students' and instructor's grading, were delivered before a meeting of the local A.I.E.E. Section. These were judged by the same grading rules by a Committee of Section and Branch Members and small prizes were awarded.

Since it was desired that every student have as much time as possible for preparation, the class was divided into small enough sections so that all papers could be given in the last half of the semester, with one paper scheduled for each meeting. The class hours of the first half of the semester were devoted to preparation. In order to avoid procrastination, arrangements were made to hold these meetings in the engineering library. The first period was utilized in showing the class around the library, pointing out the sources of material and the methods of locating information. Subjects were tentatively selected and the next two periods were spent in checking available information and making definite subject selection. Following periods were used in reading and preparation, with progress being checked weekly by the instructor. The interest shown in the use of the library, and the surprise exhibited at the wealth of information available in technical publications, indicated that many engineering students have not had much experience in this type of work. Most reference work, in other classes, calls for a few texts and too few students have taken time to follow current periodicals. To assist in reaching conclusions, an unsigned questionnaire was turned in by each student at the end of the semester. These covered the amount of outside time spent, whether it was considered worth while —with reasons—whether two outlined talks or one written paper was preferable, and suggestions for improving the course.

Answers gave an average of twenty-five hours of outside time, and it was unanimously said to be worth while. A large majority, and all of those with experience with both methods, preferred the single paper because of the opportunity for better preparation of a written paper, and more time for presentation and discussion. Comments on the value of the course stressed the value of the experience gained in searching for information and preparing the paper, the opportunity to keep up on current developments, and to learn about apparatus not covered in other classes. Many commented on being enabled to study subjects in which they had been interested but had never "found time" to look into.

From the experience to date, the writer believes that, with the time allotted to the course, the method of requiring but one well-written paper per semester gave the better results. It is thought that the work proved very interesting and worth while to the stu-

TABLE I

Grading of Seminar Papers

The A.I.E.E. has set up a basis for grading papers of student members. This does not consider that the primary purpose of student papers is to contribute to the technical advancement of the profession but rather to constitute a vehicle for the training of future contributors to the profession. For this reason greater emphasis has been placed on the written presentation and on evidence of engineering thinking than on technical value.

With some slight changes to give some weight to the oral presentation, the above basis has been used in making up the method of grading given below.

A. Content	Excellent	Very Good	Fair	Poor	Very Poor
1. Originality: Not necessarily in the subject matter, or method of attack, or laboratory research, but rather in the evidence of the author's own thinking	10%	8%	6%	3%	0
2. Survey of Subject (Analytical Procedure): The breakdown of the problem with its parts, their study and assembly from fundamental laws characterize the engineering way of attack	10%	8%	6%	3%	0
3. Importance: In engineering, potential usefulness is important. Evidence of good reason for considering the subject treated in the paper should be made clear	10%	8%	6%	3%	0
B					
1. Appropriateness: The paper shall be appropriate to the audience for which it is written	5%	4%	3%	1%	0
2. Mode of Expression:					
(*a*) Logical organization of material for clarity, forcefulness, and interest	10%	8%	6%	3%	0
(*b*) Concise and coherent expression of thoughts in good English and with proper choice of words	10%	8%	6%	3%	0
(*c*) Effective and judicious use of pictorial and graphical presentation	5%	4%	3%	2%	0
3. Adequate Introduction and Closure: The background for the paper should be clear, and the results or conclusions should be well summarized	10%	8%	6%	3%	0
C. Oral Presentation					
1. Bearing: Ease of manner, posture	10%	8%	6%	3%	0
2. Diction: Choice of words, enunciation	10%	8%	6%	3%	0
3. Delivery: Clarity of speech, lack of hesitation, ability to hold interest of audience	10%	8%	6%	3%	0
Total Grade					

Criticisms of the paper and its presentation—*i.e.* reasons for grades given above.

dent, not mainly for the knowledge gained, but chiefly for the experience in finding and preparing information from current literature. Students became acquainted with the publications of the various engineering societies and interest was stimulated in becoming members of one or another of them. A few papers were based on actual experiences or experimental work of the student, and the second semester showed an increase in the number interested in the possibility of carrying on a project of their own. It is hoped that more papers of this type will be possible in the future.

Advice to Young Men Who Seek Careers in Civil Engineering

By L. O. STEWART

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What is Civil Engineering

There were practitioners of the profession which we call civil engineering thousands of years ago. Such huge projects as the Mesopotamian irrigation canals, the pyramids of Egypt, the temples of the Mayans in Central America, the great Wall of China, and the Roman highways and aqueducts must have been planned and built by men who were skilled both in the art and science of construction. In those early days these men were known under several names. In ancient Egypt they were called superintendents. Archimedes was a wise man in Carthage. Vitruvius, a Roman of the first century before Christ, was called an architect, a word which came from the Greek and meant chief builder.

During this period another group of men was carrying on similar activities in connection with warfare. They built fortresses and implements of destruction, and canals, roads, bridges and breakwaters. Their primary purpose was military. Probably Cyrus had such men with him about 500 B.C. when he diverted the Euphrates River and took Babylon. Certainly Julius Caesar had such assistance when he crossed the Rhine. Louis XIV had the advice of Vauban his military engineer during the latter half of the 17th century.

The men who did these things seem to have been called "engineers" in Italy and France seven or eight hundred years ago because they were ingenious and conceived things out of their heads, and not because they were familiar with and able to operate engines. This difference is very important. Many erroneous usages have grown out of the misconception of the derivation of the word "engineer." Undoubtedly, the words "engine" and "engineer" sprang from a common root. But "engineer" in the professional sense did not grow out of "engine," although it is used frequently and popularly to designate one who operates an engine. The form of the word in most European languages means "ingenious designer." Clearly those who first took the name "engineer" to describe their work were designers and creators, not machine or engine operators.

Civil engineering as an art and profession may be said to have originated in France early in the 18th century. But John Smeaton, an Englishman, was the first man to a call himself a "civil engineer" to distinguish his work from that of the military engineers. That was in 1761. Smeaton was a designer of bridges and other structures, drainage works, pumps, and other machines. He is remembered as the designer and builder of a great lighthouse, the Eddystone. His report

that structure contained the phrase "my profession of civil engineer," and he may be called the first civil engineer.

Our daily activities depend upon the work of the civil engineer. He plans, designs and builds the water and sewerage systems that safeguard our health; he builds dams that store up energy for power, and reservoirs that hold water for many uses; he plans and builds transportation systems that carry us smoothly and safely and that bring us food from everywhere; he designs and constructs the buildings in which we live and do our daily work; he provides the engineers of industry with well-planned and properly designed and constructed facilities with which they produce innumerable products.

Essentially, the civil engineer serves the public in an intimate and direct way. He builds things, such as bridges, roads, dams, tunnels, that are specific and individual units, each requiring study, special plans, and unique construction arrangements. For example, the Boulder Dam could not be built at Fort Peck; the water supply system of New York could not be copied for Chicago; and foundations for a building at New Orleans would be different from those for one at San Francisco. Therein lies a significant difference between the works of the civil engineer and those of his brother-engineers in industry, the chemicals, electricals, mechanicals. They help to make machines and goods in large quantities for early consumption. But the civil engineer builds a bridge that will last a lifetime.

What is the Work of the Civil Engineer

We may classify the work of the civil engineer according to the field, such as highway, sanitary or structural, or according to the function, such as construction, design, research or sales. The American Society of Civil Engineers divides its activities into divisions which are named as follows: city planning, construction, engineering economics and finance, highway, irrigation, power, sanitary, structural, surveying and mapping, waterways. Several of these fields are emphasized in civil engineering curricula, usually as an optional group of courses in the senior year. A discussion of several of these will help to clarify our picture.

Fields of Civil Engineering

Surveying includes mapping and geodesy. All civil engineers receive training in surveying and map making, and many begin their careers on the surveys which are the first step in most engineering projects. Many men make surveying and map making their life work, principally with the Federal, State and County bureaus. Developments in aerial mapping that will come out of this war will produce significant improvements in the entire surveying and mapping field.

Highways, railways and *airports* have many similar problems so they are combined, sometimes, under *transportation.* The work includes planning, location, design, construction, and maintenance of roadbeds, bridges, culverts, tunnels, grade separations, airstrips and runways. Recent studies and uses of soil have opened a new and growing field, closely related to the design and construction of roadway and runway surfaces, called Soil Engineering.

Hydraulic deals with the planning, design, and construction of dams, reservoirs and systems of conduits or canals for impounding and distribut-

ing water for municipal supplies; the reclamation of swamp lands and the control of rivers' flow; the planning, design, and construction of water power and irrigation projects; river and harbor improvements, and many others.

Sanitary and *Water Supply* deal with the collection, treatment and disposal of wastes from households and factories, and of storm water from cities and towns; the collection, treatment and distribution of public water supplies. The problems of public water supply and waste disposal are closely related to each other and to the broad field of public health.

Structures are important in all of the fields of civil engineering. Specifically, this branch has come to mean the special technique required for the design and construction in steel, concrete and wood of bridges and buildings.

The Functional Fields

In the preceding discussion we have used such words as design, construction, planning. These words designate the specific type or kind of work performed and may apply to any of the fields of civil engineering; that is, a man might plan, design or construct a bridge, a building, a highway, a dam, or a waterworks. We shall consider some of these functions in the following discussion.

Design.—Webster's New International Dictionary says that to design means "to plan mentally; to conceive of as a whole, completely or in outline . . . to so plan and proportion the parts of a machine or structure that all requirements will be satisfied." There are many types of design: some are new creations, unlike anything that has been done; others are modifications and refinements of things already in use.

Consider, for example, the design of a bridge. This includes the selection of a type or kind of bridge, the study of a number of combinations of types and arrangements, with estimates of costs of each to determine which combination of substructure and superstructure will work out most satisfactorily from the standpoint of cost and service. Then the designer proceeds with detailed sketches, drawings and calculations whereby he determines the sizes, shapes, and lengths of members and the method of connection to adjacent members.

There is a general belief that anyone who chooses design is attaching himself to a drafting board. It is true that a large portion of a young man's first years in design is apt to be spent on jobs where facility in drafting is desirable. For this reason skill in drafting is important. But real design is much more than drafting. It is a challenge to the highest type of engineering ability. Those who have this ability, and are able to direct others, will move on to positions of enlarging opportunity and responsibility where contact with the drafting board will be supervisory only.

Construction.—The engineer on construction builds factories, tall buildings, highways, railroads, airports, bridges, dams, water and sewerage systems, and others. On large projects the work is divided into (1) the planning department which selects the construction equipment, places it on the site, lays out the route to be followed by all materials, makes sure that materials are on hand when and where needed; (2) the cost or estimating department, which would keep an accurate record of all costs and be pre-

pared to make estimates that may be submitted on proposals for new projects; (3) industrial relations, where all matters of wages, safety, health, disability, pensions, and others are handled; (4) operating department, which carries on the actual building operations.

Research has been designated as pure or applied, depending upon one's conception of the objective. The results may appear in numerous ways. For example, there may be a new product, such as a steel alloy; there may be a reduction in construction costs, such as have followed the development of new grading equipment; or, entirely new methods may be developed such as have followed research studies on the treatment of sewage wastes. The work includes a combination of exploration and adventure, sound business and commercial sense, scientific ability and persistence.

Sales.—Commercial goods and services are made to be sold. Engineering equipment and services require engineers for the selling. Civil engineers engage in the selling of construction materials such as cement, sand and gravel; construction equipment such as concrete mixers and road graders; structures such as tanks and bridges; operating equipment for sewage and water plants. These sales engineers should have good technical ability plus the personality traits that are needed by all men who deal with other people.

Administration.—This is a field for which the civil engineer seems particularly adapted by his interests, aptitudes, and education. City management typifies the work in the administration of public enterprises. Others in the same area are county and township management; the direction of various public works agencies, both state and Federal; publicly owned utilities. In the private field are large construction companies, privately owned utilities, transportation companies. In many of these organizations a civil engineering education and experience are important assets and prerequisites.

There are several other functional activities such as testing, maintenance, and operation that could be described in some detail. Each has certain techniques that demand specific abilities. Some men will be able to do one more readily than another. It is possible for a young engineer to find the area in which he fits best. When he does that he is apt to make better and happier progress than he will if he is in work for which he is poorly adapted. There is ample evidence to justify the statement that those people are most successful who from the beginning are at work for which they are best fitted by aptitude and interest. Ideally, one should get fun and happiness out of his work. When he does that he will be successful. It follows that he should seek diligently and thoughtfully for that work.

How Does One Become a Civil Engineer

Civil engineers come from two sources, (1) the "school" of experience, and (2) the colleges. Years ago when fewer people attended college there were good opportunities for young men to become civil engineers by the "self-taught" and apprentice method. But civil engineering has grown in scope and complexity to the point where a college education has become a near-necessity. So the first step on the road to a career in civil engineering is to graduate from a good school of civil engineering.

The young man will spend the first

years after graduation gaining experience in sub-professional positions, such as rodman, chainman, instrumentman, draftsman and inspector. Some of the work will require routine operations; some a high order of technical ability. Generally speaking, work in this area does not demand men with engineering degrees. It is the field of the civil engineering technician. Many graduates never rise above this level and, although they have received the bachelor's degree in civil engineering, do not become civil engineers in the professional sense.

With rare exceptions, every civil engineering graduate finds it necessary to spend some time after graduation at such an apprenticeship. During that period he may become impatient and rebellious at what seems to be a needless delay in reaching his goal, particularly so if he has to make his way in competition with men who have had little or no college education. Here he learns, if he did not realize it before, that his engineering education has done no more than to give him reasonable points of view, good methods of thinking and sound plans of attack. He still has the task of putting these into effective use.

So, we come to the question, when is a civil engineering graduate a *civil engineer*. Certainly not upon graduation. Probably not after any specified number of years of experience. We might accept the answer of the forty-six states that have engineering registration laws. They say that inasmuch as the practice of engineering involves the life, health and property of the general public it is necessary that the citizens be safeguarded against bad practice. Therefore, they require that the men who engage in the practice of engineering, which is defined and divided into several branches, shall be licensed. Before a man can receive a license to practice as a *professional engineer* in a given state he must satisfy the State Board of Engineering Examiners (by written and oral examination) that his fundamental training and experience are sufficient to assure them of his ability to do his work in such a way that the life, health and property of his clients and constituents will be properly safeguarded. Thereupon he becomes a PROFESSIONAL ENGINEER.

A second criterion is membership in a professional engineering society. The American Society of Civil Engineers is the principal professional organization for civil engineers. Its objects, as stated in the constitution, "shall be the advancement of the sciences of engineering and architecture in their several branches, the professional improvement of its members, the encouragement of intercourse between men of practical science, and the establishment of a central point of reference and union for its members." All young civil engineers who hope to achieve the high professional goal should become members of one or more such technical and professional societies because therein they will continually meet the challenge of others who are striving toward that goal.

Third, but not least important, the *civil engineer* must also do his share as a citizen of the community, state, nation, and wider international scene. He should understand other persons' ideas and be able to express his own ideas effectively. He should be able to work coöperatively with others. He should understand the dynamics of human behavior so that he may attain a sound emotional and social adjustment. He should develop such traits as self-confidence, tact, poise, leadership, ex-

ecutive ability, so that he may make the full contribution that his technical proficiency warrants.

Who Should Study Civil Engineering

When considering the following traits one should think of them from the point of view of their importance during the formal educational process as well as their use after graduation. Clearly, the former is the more significant because the man who cannot master a civil engineering curriculum cannot expect (with rare exceptions) to become a civil engineer. *Essential* as used here means *indispensable,* that is, without it one could not graduate or could not become a civil engineer.

1. Ability to do mathematics is a prime requisite. A better than average ability to learn this subject as shown by high school grades or test scores is essential.

2. Aptitude for chemistry and physics is not as significant as aptitude for mathematics. Yet a large number of scholastic failures include one or both of these. They are important basic courses.

3. Visualization, the ability to perceive the sizes, shapes, and relations of objects, and to think clearly about those relationships, is an important and desirable but not an essential trait. Plane and solid geometry in high school, and descriptive geometry in college, are courses that test one's ability to visualize.

4. Aptitude for English is very desirable but not essential. Too much proficiency in English may make one restless and dissatisfied with a technical curriculum. Too little proficiency may make the learning a slow and difficult process.

5. Because civil engineers have many contacts with the public, they should have, or should develop, personalities that make those relations pleasant and mutually enjoyable.

6. Other personal qualifications should include (*a*) honesty and fairness in weighing facts; (*b*) patience, persistence and no tendency to be flighty; (*c*) a liking for accuracy and neatness; (*d*) a sound, healthy body.

7. The typical civil engineer prefers to deal with static (resistance to motion) forces such as are met in the design of a bridge or building, rather than with the dynamic forces of moving parts such as are driving a machine. As a result, the typical civil engineer does not enjoy the study of courses where dynamic action or motion predominates; nor does he care for the type of work that must be done by the engineer in manufacturing plants, although he may enjoy watching, as many young men do, the motion of machines and the production line of a modern manufacturing plant.

Trends and Opportunities

A career in civil engineering still offers an opportunity to do outdoor work with a variety of activity and environment. This usually means a roving existence, which appeals to young men for a few years—until they marry and have a family. There are fewer of these exotic assignments than there were a generation ago when every civil engineer got his start in a construction camp. Yet there are enough to satisfy those who seek adventure. On the other hand there are more than enough jobs for those who choose to lead a quieter life.

Engineering on public and semi-public works is, to an increasing extent, becoming a function of some gov-

ernmental unit or agency, which means that increasing numbers of civil engineers may expect to become employees of the public. This is not the place, and there is not space, to discuss the comparative desirability of private versus public employment for a civil engineer. It is fair to say that the prestige and dignity, as well as salary, of those in public employment have been rising steadily during the last decade.

There are several trends that promise many favorable opportunities for civil engineering graduates during the next decade.

1. Prior to the beginning of World War II the engineering enrollment, as a whole, in American colleges had been rising rapidly. At the same time, the enrollment in civil engineering was falling. The result of this trend was a scarcity of graduates in the last pre-war years.

2. The increasing participation of government in our daily life means more employment by the government. The majority of engineers employed by governmental agencies are civil engineers. Before the War, approximately half of all civil engineers in the United States were employed by governmental agencies, federal, state or local. Both this percentage and the actual number of men are apt to increase after the war.

3. There will be a large amount of reconstruction and new construction in all parts of this world during the decade after the war. Destroyed areas must be rebuilt. Undeveloped countries such as China and Brazil must have transportation systems, houses, sanitary facilities, factories. Our own country will make more complete use of its water resources, expand its transportation system, improve its sanitary facilities, build better houses and factories. All of these things will mean work for civil engineers.

How to Select New Members and Promote Old Ones on Our Engineering Staffs

By D. T. CANFIELD

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Virtually every engineering school in the country is faced to a greater or lesser degree with the problem of augmenting its staff in the post war period. If not faced with staff changes, it is confronted with staff promotions and in most instances with both.

The School of Electrical Engineering at Purdue University is one of these schools which faces both of these problems. In anticipation of this situation a committee was appointed early in the fall to establish policies and to prepare aids which might assist the employing executive in making selections and promotions. This paper is a summary and discussion of the findings of this committee.

As stated in the title, the problem is a two-fold one that readily divides itself into:

1. Selection of New Staff Members
2. Promotion and Tenure of Existing Staff Members.

I. Selection of New Staff Members

1. *The Check List*

Check lists have been found to be the most effective aid to military inspectors that have yet been devised. They not only act as a guide but prevent the omission of some vital item. For example, when used in the preflight inspection of aircraft, they have been the means of saving many a life as well as a valuable asset. For the same reason it was felt that a check list of the qualities that a candidate for a staff position should possess would be the most practical aid that could be devised. The check list finally adopted is as follows:

I. *Knowledge of Subject to be Taught*
- (a) Educational background and degrees held
- (b) Practical experience—nature of
- (c) Professional standing—national and local
- (d) Writings—textbooks, papers, others
- (e) Lectures—national, local
- (f) Interest in field to be taught

II. *Teaching Ability*
- (a) Experience—nature of
- (b) Pedagogical training
- (c) Ability to inspire and lead students
- (d) Ability to get along with students
- (e) Fairness and open-mindedness in dealing with students

III. *Attitude Toward Colleagues*
- (a) Honesty—give credit where credit is due

(b) Ability to cooperate—lack of professional jealousy
(c) Ambitious—but not at another's expense
(d) Willingness to learn from others
(e) Willingness to assist others

IV. *Social Qualifications*
(a) Ability to meet and impress people well
(b) Acceptability of family
(c) A reasonable proportion of the social graces
(d) Likelihood of being a good citizen in this community
(e) Ability to be happy in this community

V. *Health and Habits*
(a) Are physical disabilities, if any, detrimental to success?
(b) No evidence of excesses in social activities
(c) Degree of enthusiasm, industriousness, tenacity
(d) Degree of common sense
(e) Degree of financial sense

VI. *Interest in and Ability for Research*
(a) Likes to do research
(b) Type of research interested in
(c) Work done or contemplated

2. General Policies

(a) It is recognized that the attached list of specific attributes for new staff members is not complete. Moreover it is obvious that no one individual will possess all of these qualities to the *n*th degree. Therefore the employing executive must of necessity exercise judgment in determining at what point a given lack in a specific trait will disqualify an applicant.

(b) It is further recognized that there are certain general considerations or policies which cannot be covered by specific personal traits. These are:

1. New applicants, particularly for ranks above that of instructor, should be invited to the campus at university expense and presented to and interviewed by the existing staff above the rank of instructor.
2. Since inbreeding can be both an asset and a liability, the degree to which the staff is made up of locally educated members should be watched carefully. It is not felt that there exists a particular percentage at which the asset turns into a liability, but it is believed that not over one-third of the staff of professional rank should be men educated wholly at the employing institution.
3. It is felt that young men just starting in the profession of teaching should serve for a term or two as assistants to other staff members.
4. It is also desirable that beginning teachers be given a definite training program and not left to develop solely by experience or chance.
5. All half-time assistants who do not possess at least the M.S. degree should be required to work for this degree and pursue their work with diligence. In fact a limit of two or three years might be set as a general policy.
6. In engineering it is felt that work toward the Ph.D. degree might well be optional and summer work in an engineering capacity in industry be considered equivalent thereto.
7. Appointment as full time *Assistant* or as *Graduate Assistant* should be for one year only. There is presumption of one successive annual reappointment predicated upon satisfactory work. An important

purpose of assistantships is to enable meritorious students to complete work for an advanced degree while performing services for the university. It is expected that only in rare instances will an Assistant be promoted to an Instructor. In general the Assistant should expect to move on to some other institution or into practice within two or three years from his initial appointment.

Perhaps a brief discussion of this check list is in order. Starting with Group I, "Knowledge of Subject Matter to be Taught," the subdivisions are the obvious ones. The degree of a candidate's proficiency in these items may easily be determined from documentary evidence.

Group II, "Teaching Ability," on the other hand is less subject to documentary evidence. One interview is at least essential. Much can be determined from the candidate's ability to sell himself to the interviewing officer. Some information can be obtained from recommendations, but consultation with previous employers is apt to be even more effective.

Group III, "Attitude Toward Colleagues," is even more intangible, yet is vital to a smooth running harmonious staff. Many a teacher has had the unfortunate experience of trying to work with a fellow staff member, with whom it is difficult, if not impossible, to "cooperate." Such a situation, if prolonged, becomes unbearable. The best source of advance information in this regard is undoubtedly the candidate's previous associates. Consultation with them, be they his fellow students or staff members, would be most illuminating in this respect.

Group IV, "Special Qualifications," may, at first thought, appear to be of minor consequence. However, experience has proved that such is by no means the case. Some individuals just cannot be happy in a small town. Others, without realizing it, may not be content in a large one.

Placing a big city enthusiast in a small town environment, even if the individual tries his best to adapt himself, is bound to result in inefficient and often ineffective teaching.

Group V, "Health and Habits." All of us have known examples of individuals with physical handicaps who have risen superbly above these handicaps. Take our late President for example. But we have also known others whose physical handicaps have resulted in maladjustments of one form or another. These obviously must be guarded against. However, it is the last two items to which special attention should be directed. Common sense and financial sense are both intangible items but of great importance. An individual who continually borrows from his friends soon does not have any. One whose pay check is invariably spent before he gets it and is chronically in the position of a debtor can cause his employer a great deal of trouble. Beware of such an individual.

Group VI, "Interest and Ability for Research," is not intended to imply that good teachers are necessarily good research men or vice versa. It is merely a contributing factor. It is evidence of the enquiring type of mind, an asset in engineering teaching. Even total lack of research activity might be tolerated provided other qualities existed in sufficient magnitude.

Of the general policies in the check list, items 2 and 6 may be questioned.

A staff made up one hundred per cent of individuals educated in the local institution is apt to be narrow, ingrown and to lack breadth of vision and experience; on the other hand, a staff made up of members, all educated elsewhere, may lack local color, enthusiasm and tend to be unsympathetic with the students. Experience seems to indicate that a proper mixture works best. Just what is the proper mixture may vary with local conditions and instructor availability.

The importance of the Ph.D. degree for teachers varies between those teaching academic subjects and those teaching engineering subjects. In the latter case practical experience in industry makes for more effective classroom teaching. Of course if a candidate possesses both, so much the better. The point that is intended to be made is that the Ph.D. degree is not the only evidence of a good teacher, but that experience in the practice of engineering may be of equal value. On the other hand possessing the Ph.D. degree or years of engineering practice is not conclusive proof that the individual is a good teacher.

II. Promotion and Tenure

About all that can be done with the second phase of the problem is to outline several policies. A rigid set of specifications that could not be bent to fit different personalities or extenuating circumstances would be worse than useless.

The following five policies covering the several academic ranks are submitted as being both sound and, which is more important, workable.

1. In recommending staff members for promotion, the table of organization should be considered only to the extent that budget considerations and extreme top-heaviness may exist. In other words, in general, promotions should be based on individual merit and not any more than absolutely necessary on the number of staff members in a given rank.

2. The rank of *Professor* should be recommended only after careful consideration of the individual's character, scholarship, productivity, teaching ability and reputation among his peers in his own field. It should be recommended only for men who have been so tested that there is a reasonable certainty of their continuing usefulness to the university throughout the remainder of their working years. It should be reserved as a mark of distinction in the field of scholarship, of instruction or professional attainment, and should not be granted as the reward of seniority only. It should not be granted as a recognition of usefulness in administration only.

3. The rank of *Associate Professor* should be recommended primarily as a step in the line of promotion to those men whom the university is willing to keep and in due time probably promote to a full professorship. Although promotion to an Associate Professorship should not be understood to insure further promotion, it should carry with it reasonable assurance of continued employment. It should be considered as evidence of recognition by the university that the individual concerned has demonstrated definite abilities as a teacher and/or research worker and the capacity for continuing growth and usefulness.

4. The rank of *Assistant Professor* should be recommended only for a candidate who has a record of considerable attainment, scholastical

or professionally, as may be evidenced by possession of an advanced degree with teaching experience, or a recognized record of high accomplishment in teaching, industry, or both. A man should not be recommended for promotion in rank to Assistant Professor who is definitely judged unworthy of promotion beyond that rank, although there should be no presumption in appointing the man to an assistant professorship that he will in due course, and as a matter of course, receive promotion to a higher rank. After promotion or appointment as an assistant professor, there is a presumption of reappointment for at least two years.

5. The appointment to an *Instructorship* carries with it a presumption of two succeeding annual reappointments, but there is no presumption of further re-appointment nor any obligation to promote to an assistant professorship after several years of service. It should be clearly understood that not all meritorious instructors can be promoted; that reappointment after the first year's service implies satisfaction with the individual's work as an instructor but gives no assurance that further promotion will follow. Promotion to the rank of Assistant Professor should not normally take place until after three to five years of service as Instructor. Should promotion to the rank of Assistant Professor not take place at the close of five years of instructorship, it should be regarded as a suggestion to the Instructor that he look elsewhere for his promotion. It should be the general policy not to continue the appointment of instructors beyond five years. This policy is in the interests of the instructor as this is a particularly important period in his professional life. It is believed that instructors should broaden their experience by connection with another institution or by professional practice prior to being appointed to professorial grade. The school is also under an obligation to make available opportunities for promising young men to obtain experience and training as instructors, and it can do this only by limiting the length of their tenure.

Little comment is necessary concerning the above items. Should the time in grade not fit conditions in some other institution it can be modified. The policies are of a general nature and afford ample opportunity for executives and/or committees on promotions, whichever may be in vogue, to use their discretion in any particular case.

If these policies are adopted, prospective candidates for staff positions should be advised of them at the time of their employment. This should be done to prevent any misunderstanding or future embarrassing situations both on the part of the candidate and the institution.

In conclusion the writer wishes to acknowledge the valuable assistance of the members of the committee from whose report this paper is taken. They were Professors A. N. Topping, R. P. Siskind, G. V. Mueller, and G. C. Blalock. In addition the committee received many valuable suggestions from a similar report made by the College of Engineering of New York University. Finally no particular originality is claimed in this paper. If there is any merit in it, it lies in the collection and codification of generally accepted principles and policies.

Recommendations for High School Mathematics

By W. J. SEELEY

The following is a brief resumé of recommendations made to high school mathematics teachers at the 1944 session of the Duke University Institute for Teachers of Mathematics.

It has been observed that the student brings with him in his mathematical equipment from high school two common faults. The first is an unwillingness to carry out arithmetical operations with any degree of accuracy. The student seems to be satisfied when he can say that the answer is "about" so and so, and he shows little interest in arriving at anything like an accurate result. No engineering work is ever designed on results that are "about" right. The other fault is a seeming disregard for the proper location of the decimal point, and students resent having problems marked wrong just because the decimal point was in the wrong place. They do not consider it to be a serious error, but it is extremely serious indeed!

A good deal of the blame for these faults may be attributed to the clumsy system of arithmetic now in use. It so completely befuddles the student in its operation that he loses sight of the end point of the computation. It is suggested that as a means towards simplification and accuracy the method of dividing out tens and using exponents be introduced. It is almost universally used by engineers and is derived from the simple theory of exponents as taught in introductory algebra. For example, take the two numbers 46,800 and 0.00675 and write them as 4.68×10^4 and 6.75×10^{-3}. In any arithmetical operation with these two figures the order of magnitude may be obtained easily by inspection, thus accurately setting the decimal point. The correct numerical value then may be obtained by long-hand, logarithms, or slide rule (if the high school student is so equipped).

This method is particularly advantageous when computations are made by logarithms. The following examples are given for illustration.

(1) $$46800 \times 0.00675 = 4.68 \times 10^4 \times 6.75 \times 10^{-3}$$
$$= (\text{antilog } [\log 4.68 + \log 6.75]) \times 10$$

(2) $$\frac{46800}{0.00675} = \frac{46.8 \times 10^3}{6.75 \times 10^{-3}} = \frac{46.8}{6.75} \times 10^6$$
$$= (\text{antilog } [\log 46.8 - \log 6.75]) \times 10^6$$

(Notice that the numerator is made larger than the denominator in order to avoid negative quantities.)

$$(3)\qquad \frac{0.00675}{46800} = \frac{6.75 \times 10^{-3}}{4.68 \times 10^{4}} = \frac{6.75}{4.68} \times 10^{-7}$$
$$= (\text{antilog } [\log 6.75 - \log 4.68]) \times 10^{-7}$$

$$(4)\qquad \left[\frac{46800}{0.00675}\right]^{1/3} = \left[\frac{46.8 \times 10^{3}}{6.75 \times 10^{-3}}\right]^{1/3} = \left[\frac{46.8}{6.75}\right]^{1/3} \times [10^{6}]^{1/3} = \left[\frac{46.8}{6.75}\right]^{1/3} \times 10^{2}$$
$$= (\text{antilog } \tfrac{1}{3}[\log 46.8 - \log 6.75]) \times 10^{2}$$

It is to be noted from the above examples that the 10's with exponents are completely removed from the logarithmic computation, leaving only simple numbers to which logarithms are applied. In this way the use of negative characteristics may be eliminated entirely. This has merit. The student no longer has to worry about the correct application of $9\cdots-10$. In fact, logarithmic computation may be taught without ever having to mention that there is such a thing as a negative characteristic.

Trigonometry

Engineers use a trigonometry that is quite simple compared with the abstruse material presented to the high school student. The whole subject should be boiled down to simply sines, cosines, and tangents. No other functions are necessary except in civil engineering where they may be developed as needed. Engineering handbooks show tables of only these three functions and there is no necessity of loading down the high school student with the excess baggage of seldom-used functions. Reducing the functions will give time for functions of half-angles, multiple angles, and powers, to say nothing of the interesting history of trigonometry. A final recommendation is the use of degrees and decimal fractions, rather than the clumsy system of degrees, minutes, and seconds. Tables are available and the trend is in that direction.

Methods in Engineering Laboratory Instruction*

By J. R. WHITE

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Statement of the Problem

The problem under investigation in this study consisted of determining the relative effectiveness of a group-laboratory method and a lecture-demonstration method of instruction in the laboratory phase of an engineering course entitled "Materials of Engineering." The comparison was made with respect to certain learning outcomes; namely (1) the immediate recall of factual knowledge; (2) the ability to understand and apply generalizations of science; (3) the delayed recall of factual information and the delayed growth in ability to understand certain generalizations; (4) the development of skill in laboratory techniques.

Development of Materials Testing

A study of the development and growth of the materials-testing laboratory and of the courses in the physical properties of materials was undertaken to provide an overview of the background of present practices in the laboratory. The types of testing machines and strain reading instruments were reviewed in some detail since a complete understanding of their operation and proper use was believed essential for an adequate understanding of the nature of this study.

Historical Background of the Problem

An exhaustive survey of previous experiments in this field disclosed that studies in laboratory procedures in general at the college level are not nearly as numerous as those at the high-school level and those in the field of engineering education are exceedingly rare. All of the studies made in the field of laboratory instruction can be classified under one of three heads: (1) studies made to compare the relative merits of lecture-demonstration methods and individual laboratory work; (2) studies made to determine the effect of reducing the time devoted to laboratory work; (3) studies made to determine the effect of a substitute, usually outside reading, oral quiz, or recitation, for all or part of the laboratory work. The large majority of the studies in this field have been of the first class. The nature of these related studies showed quite clearly that there was an awareness among engineering educators of the need for the improvement of instruction in the engineering testing laboratory. The need was also evident for more objective investigations of the methods now in use in engineering testing laboratories.

* Abstract of doctor's dissertation "A Comparison of the Group-Laboratory and Lecture-Demonstration Methods in Engineering Instruction."

None of the reviewed studies dealt with a scientific analysis of these two methods of instruction in the engineering testing laboratory at the college level. Although a few studies compared methods of teaching that were similar in principle to those compared in this study, none of them defined specifically all four of the outcomes, as a basis for comparing student achievement by these methods.

Procedure

Description of the Classes

The group-laboratory and the lecture-demonstration groups each consisted of laboratory sections distributed as follows: three day-session and one evening-session sections during the first semester and during the second semester one day-session and one evening-session section. The course, as offered by the Civil Engineering Department of the School of Technology of the College of the City of New York, consists of two one-hour lecture periods and one three-hour laboratory period each week for one semester (16 weeks). This study deals only with the laboratory phase of the course.

Description of Teaching Methods

At the first meeting of each section at the beginning of the semester the engineering testing laboratory was inspected and the students were acquainted with the various types of testing machines and strain reading instruments and their operation was explained in detail. Under the group-laboratory method of instruction, the students operated as squads consisting in general of three students, but in no case more than four or less than two members. The squads proceeded at their own rate and conducted experiments on six materials of engineering (brick, cast iron, concrete, nonferrous metals, steel, and wood) with no assistance from the instructor unless such aid was requested by the student. Under the lecture-demonstration method of instruction, all experiments were demonstrated by the instructor, leaving the students entirely free to devote their attention to the observation of the action of the test piece and the taking and recording of their observations. During the experiment, discussion between the instructor and students was continuous.

Construction and Administration of Tests

Three written tests, three practical tests, and a student judgment questionnaire were constructed after reviewing standard texts, laboratory manuals, previous examinations, and the American Society for Testing Materials standards. A jury of eight qualified persons was selected to evaluate this material and determine its validity. Both the written and practical tests were given at the beginning of the term's work and again at the end of the semester. Six months later, the same written test was given as a delayed-recall examination. The reliability of the written examination was determined by dividing each part of the test into two groups, odd-numbered questions in one group and even-numbered questions in the other group. The coefficient of correlation of the scores on these halves was computed by the product-moment method and then corrected by the Spearman-Brown formula. The values obtained were Part I .72, Part II .52, Part III .26, and Total Test .75. The reliability of the practical test and questionnaire

was not determined due to the small number of test items and situations.

Method of Equating Groups

The initial similarity of the group-laboratory and lecture-demonstration sections was determined by comparing the means and standard deviations of scores on the following measures: (1) the students' college averages based upon all grades obtained in previous courses by them from the time they entered college until they registered for the course in "Materials Testing"; (2) the 1938 and 1939 editions of the American Council on Education Psychological Examination for College Freshmen prepared by L. L. Thurstone and T. G. Thurstone; (3) the term grades obtained by the students in the prerequisite course "Mechanics or Resistance of Materials"; (4) the scores made on the written pretest on the "Materials of Engineering."

Collection of Data

Using the previously described groups, each one of the tests was administered according to standardized instructions. The investigator was assisted by two other instructors who were thoroughly acquainted with testing procedures. Each instructor taught one group of students by the group-laboratory method and another group by the lecture-demonstration method of instruction. Each group met for one three-hour laboratory period each week during a semester of sixteen weeks.

Treatment of Data

Table I summarizes the number of students available for comparison on each of the evaluation instruments. The means and standard deviations (S.D.) for the Absolute Averages,

TABLE I

Total Number of Students Available for Comparison in Each Group

Item	Group-Laboratory	Lecture-Demonstration
Initial and Final Written Test	75	75
Delayed-Recall Test	24	21
Initial and Final Practical Test	72	76
Student Questionnaire	55	42
Absolute Average	69	72
Thurstone Psychological	60	64
C.E. 110 Term Grades	55	47

Thurstone Psychological Scores, Resistance of Materials (C.E. 110) term grades and written pretest scores were determined. Table II summarizes these values.

TABLE II

Initial Comparison of Group-Laboratory (G.L.) and Lecture-Demonstration (L.D.) Sections

	Absolute Average		Thurstone I.Q.		C.E. 110		Written Pretest*	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
G.L.	78.1	6.0	79.4	12.8	74.6	11.4	70.4	23.4
L.D.	77.6	5.8	75.4	15.9	69.1	11.4	73.0	17.6

* Total test scores.

The statistical significance of the difference in mean values for each of the four measures of initial similarity was computed by determining critical ratios. (Absolute Average .55, Thurstone Psychological 1.55, C.E. 110 2.43, and pretest total $-.77$.) The only measure that showed a possible initial significant difference between the two groups was the C.E. 110 term grades. A further analysis of this difference by correlations disclosed that this one case of dissimilarity was not pertinent to the experiment.

Comparisons of the results of the method of instruction were made on

the basis of final test means, standard deviations, and critical ratios based upon gains or losses. The effect of the method upon the inferior and superior students was also analyzed by means of chi-square. This method of inspection was likewise used on the delayed-recall written test and practical test.

In order to complete the analysis, the possibility of scores on one measure or test affecting the work obtained on any other evaluation instrument was determined by correlations.

Results

Table III indicates the results of the two methods of instruction in terms of final written test scores.

TABLE III

Final Written Test Results

	Part I		Part II		Part III		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
G.L.	76.5	15.1	44.6	9.8	13.1	3.2	133.7	23.4
L.D.	70.1	12.3	42.4	7.6	12.5	4.9	125.8	17.7

The critical ratio for Part I was 2.19, Part II 2.62, and total test 3.13, indicating significant differences in favor of the group-laboratory method of instruction. No critical ratio was computed for Part III due to the low reliability of this test. Standard errors of the means and standard deviations were also computed and were found to be analogous.

A similar analysis on the delayed-recall test resulted in group-laboratory means of 74.7 for Part I, 45.6 for Part II, 13.8 for Part III, and 134.4 for the total test as compared with corresponding values of 71.2, 43.0, 15.0, and 130.0 for the lecture-demonstration section. The critical ratios based upon gain or loss from final to delayed-recall test were .13 for Part I, 1.61 for Part II, and .76 for the total test.

In the investigation of the results of the practical test the critical ratios ranged in size from -1.76 to 4.52.

The effect of the method of instruction upon the inferior and superior students was further analyzed by means of chi-square. In all tests the chi-square values showed that the mean difference in the amount of progress made by the two groups was typical of the difference throughout the entire range of progress. Therefore, interpretations of growth in ability or skill based upon mean values can be considered valid.

The intercorrelations between the various evaluation instruments as well as correlations between test scores indicated that there was a negligible relationship between the performance of the student on one measure and his performance on any of the other evaluation instruments. The correlations ranged between .46 and $-.30$ with most of the values grouped about zero.

The average score for the group-laboratory section on the student questionnaire was 12.85 as against 11.28 for the lecture-demonstration group.

Student reaction to the method of instruction is included in Table IV.

TABLE IV

Tabulation of Student Reaction to the Method of Instruction

Method	No.	Favorable Opinion	Unfavorable Opinion	Undecided
G.L.	55	49	3	3
L.D.	42	17	22	3

Digest of Findings

In comparing the group-laboratory method with the lecture-demonstration

method of teaching the laboratory phase of a course entitled "Materials of Engineering" in the testing laboratory to a group of students when comparisons are based upon the tests and measures used in this study, several conclusions seem reasonable and justifiable.

1. The group-laboratory method was found to be the superior method with respect to achievement on tests covering the recall of factual information.

2. Students of all abilities subjected to the group-laboratory method of instruction were equally superior to similar students exposed to the demonstration method.

3. The group-laboratory method produced trends in favor of that method with respect to the ability to generalize.

4. The group-laboratory method resulted in higher mean values on the delayed-recall of factual information and the ability to generalize but in no case was this difference found significant.

5. The group-laboratory method was found to be the superior method for the development of manipulative skills.

6. In every instance where a reliable or significant difference between the two groups was found, it was always in favor of the group-laboratory method of instruction.

7. The instructors reported no noticeable difference in the caliber of the students' reports regardless of the method of instruction.

8. The students prefer the group-laboratory method of instruction.

Educational Significance

The results of this study are educationally significant in that no previous studies have been reported in which tests and materials of the type used in this study were used. It has value in contributing some evidence concerning the relative merits of two methods of teaching a course in engineering materials with respect to accomplishments in each of the four outcomes investigated in this study. It is possible that the description of teaching procedures involved in the two methods compared in this study, as well as the techniques which were used in measuring growth in each of the outcomes, will be of value to teachers of engineering in modifying their own methods of instruction toward better accomplishment of these generally accepted outcomes. Should the results of this study help to clarify the problem, its educational significance has been established.

A Report on

The Future of Mechanical Engineering Education*

By COLIN CARMICHAEL

Associate Editor of Machine Design

In line with the general theme of the convention, this report is concerned with the trends which may be expected in mechanical engineering education after the war. Comprising a summary of the views of approximately two dozen persons representing a cross section of both industry and the colleges, the discussion covers five main topics:

1. Effect of war experiences
2. Curriculum
3. Faculty and teaching methods
4. Personal development of the student
5. Content of specific courses

Although most of the thoughts expressed are practically direct quotations from those who contributed to the report, specific acknowledgement of sources has been omitted. This is in accordance with the desires of a few and to preserve the continuity of the discussion. Contributors are listed at the end of the report. Their generous response to our request for their viewpoints is deeply appreciated.

War Experiences

While war experiences have temporarily changed the procedures of engineering education, they have not indicated any great necessity for radical changes. Engineering colleges faculties have been brought closer to the realities of their profession and it may be expected that a firmer tie-in with industry in the future will result.

Teaching procedures which were developed for the production of quickly usable personnel will leave their mark through more general recognition of visual aids, a trend which had already set in before the war. Intensive training techniques employed in certain programs are considered ineffective as an instrument of engineering education. While certain types of intensified training courses will be necessary, it is thought that they should be administered separately from the collegiate engineering institutions, perhaps by technical institutes. An extension of education between the levels of high schools and colleges may be expected.

Although it will be no news to this group that there is unanimous opposition to the continuance of any form of accelerated programs, it may be of interest to summarize some of the arguments offered against year-round operation:

1. Students grow weary and restive, become stale from too much classroom work.

2. There is no opportunity for the students to gain practical engineering

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background experience in vacation jobs or to help earn college expenses.

3. A certain period is required for subject matter to soak in and the learning process needs both the strengthening of repetition and the stimulation of interruption. Subjects are covered so rapidly that students become saturated on the surface and fail to absorb because of lack of time for penetration. As a result they seem to lack the ability to apply fundamental knowledge to unfamiliar situations.

4. Students are young in years, inexperienced and immature upon graduation.

It is pointed out, however, that the possible requirements of universal military training may necessitate some form of year-round program, although intensive training techniques will be abandoned in favor of customary types of instruction.

Two weaknesses in the present setup have been exposed under the stress of emergency operation. The first is the acknowledged necessity for strengthening secondary education in English, mathematics, and physics. When high school students are permitted to elect the required 15 or 16 credits to be used later for admission to college, great harm has resulted in their preparation for scientific and professional education. Such freedom of election for immature high school students has been adjudged based on unsound educational principles.

The second practice that has received definite criticism is the tendency on the part of our colleges of engineering to attempt to give graduate level instruction to undergraduate students before they have been thoroughly trained in the fundamental sciences of their particular field. It is suggested that there is need for engineering educators to examine their curricula critically to determine whether certain courses of graduate level are not being offered in the senior year primarily to insure enough students in the courses to justify offering them.

While the readjustments after the interruption of wartime courses will afford a rare opportunity to overcome inertia of personal prejudice or vested interests which may have prevented long overdue modernization of the students' program, it is pointed out that the war has tested and verified the fundamental soundness of our plan of mechanical engineering education before the war. No serious weaknesses have appeared either in comparison with our allies or in competition with our enemies, and our mechanical engineers have succeeded admirably in the solution of the unexpected and various problems of war.

Curriculum

As might be expected, the greatest volume of comments from both industry and the colleges is concerned with curriculum. While there is general agreement that the present balance between scientific and engineering fundamentals on the one hand, and specific technical procedures on the other is reasonably good, there is some criticism of the tendency toward over-specialization. Industry prefers graduates who have had a thorough course in engineering fundamentals, and is willing to train these men in the know-how peculiar to its own activities. Men who are well versed in fundamentals prove to be better material for grasping the details of technical procedure.

Considering the various types of activities in which mechanical engineering graduates engage—production, research, design, management, teaching

—it has been suggested that engineering courses should be arranged for two groups of engineers:

1. Men who will be department foremen, supervisors, directors, sales engineers, etc.

2. Men who will be designers, consulting engineers, technical experts, researchers, etc.

For the first group a broad but not intensive education is needed and advanced physics, mathematics, etc., are superfluous. The second group needs a double dose of mathematics, physics, mechanics, strength of materials, and other subjects that go into the making of a good practical engineer or designer. It has been pointed out that the colleges have not entirely fulfilled their obligations when it is necessary for many of our manufacturing organizations to employ physicists as mechanical engineers for work that carries an engineering title, but for which experience has indicated a physicist has the greater scientific qualifications.

Probably the mechanical engineering profession can make one of its greatest contributions to engineering education by more effective guidance to men who desire to enter the engineering colleges. Too many men have been permitted to advance to the baccalaureate degree as mediocre engineers, when they could have done themselves more good and assisted industry vastly more if they had been trained for production at the institute level rather than the baccalaureate level. Such engineering-minded men can successfully take their places as top sergeants of the American production line.

Specific suggestions for detailed improvement in the curriculum may be summarized as follows:

Specialization during the undergraduate curriculum should be reduced to a minimum.

Mathematics and physics courses should be strengthened and better correlation provided between laboratory and lecture in physics.

Physics courses need adjustment to serve more adequately as prerequisites for later courses in mechanics, electricity, engineering materials, etc.

All engineers, particularly the mechanicals, need a strong course in metallurgy.

Courses in the senior year should tie together the fundamental courses of earlier years to demonstrate to the student how his basic knowledge should be applied.

Efforts of some M.E. departments appear to be spread out too thin over a wide range of subject matter to be effective in preparing a man for creative endeavor. Practices which are common to all the fields of activity in which mechanical engineers engage could be taught as fundamental subjects rather than as compartments in the fields of limited application.

Faculties should clearly define the objectives of their curricula so that each member in teaching his subject matter is concerned not only with his own small field of endeavor, but has the picture of the curriculum as a whole.

Practical English, including report and letter writing and oral presentation, should be strengthened, making certain that the entire engineering faculty pays attention to the use of good English in their contacts with the students.

Strengthening of the fundamentals may be effected by eliminating such subjects as shop courses that aim at teaching techniques rather than fundamental conceptions, advanced courses

in machine design based on empirical data, much of the present material taught in mathematics for theoretical demonstration, and much of the present M.E. laboratory procedures.

Inclusion of all the basic courses deemed essential to a well-rounded curriculum leads inevitably to consideration of the five-year course, which is favored in some quarters. Some feel that the number of engineering subjects should not be increased, but rather that a more thorough job should be done on the present subjects with perhaps addition to the arts courses and social sciences.

As an alternative to the five-year undergraduate course, there is a strong possibility that professional engineering education may be established on a graduate basis. As expressed by President Harvey N. Davis in a recent address to the trustees of Stevens Institute: "Undergraduate training is not the end but the beginning of preparation for professional service and leadership in this expanding field as in others. Engineering colleges generally may see in the not distant future, as some do already, the wisdom of overhauling the prevalent system of specialized curriculum leading to specialized undergraduate engineering degrees and replacing them with more general, less specialized undergraduate curricula in the fundamentals of engineering as a prerequisite for advanced degrees in specialized branches."

Social Sciences

For a decade, engineering educators have discussed and advocated an increase in the proportion of time alloted to the social-humanistic studies and a better organization of this division. Few colleges, however, have actually done much about it.

Industry feels that the engineer not only as a citizen but as an individual who hopes to gain a position of leadership in industry should have acquired from his college training some appreciation and understanding of the broad social and economic forces in the world in which he lives.

While it is generally agreed that the development of social intelligence is so important that it should not be left to chance alone, the consensus is that inclusion of more of the so-called social sciences in the curriculum should not be permitted to weaken the instruction in technical sciences which are less likely to change with the current fashion in human thought. Moreover, most mechanical engineers with the exception of those having strong industrial engineering leanings, at first go into work in which success depends primarily on technical ability. Such formal courses as are included should, it is felt, be placed toward the latter part of the curriculum. The student who enters an engineering college usually is more interested in the technical subjects and every effort should be made to capitalize on this enthusiasm by including as much science and technology as possible during the first two years.

In presenting social science courses to young engineers, it may be well to de-emphasize the "science" aspect. Otherwise he may try to apply such science with the same kind of mathematical precision as his machine design, with unhappy results.

It is felt that the effect of social and economic forces on the day-to-day work of the engineer needs to be made clear by at least some teachers in the more technical fields. Engineering faculties might profit from taking certain courses in human relations and

passing these qualifications along to the young engineer in connection with their engineering teaching. Inasmuch as a major factor is the point of view of the instructors who have the power to create ideals in the minds of the students, a series of conferences and working sessions by engineering, social science and other members of the faculty has been suggested. Such conferences might be devoted to working into engineering text material the historical, liberal, social science and other factors which are likely to tend to make engineers better leaders. They would serve also to strengthen the instructors themselves in these ideals.

Other substitutes for formal courses also are effective in widening the engineer's horizon. Employment in a part-time job that requires making satisfactory contacts with a great number of people is a desirable experience for the engineer who is inclined to be introspective. It is possible for the student to learn much through participating in student branches of engineering societies, intromural athletics, and fraternities. It might be well for engineering schools to make this sort of thing an official activity and give the students the social counsel of the staff as well as the professional.

Supplementing the formal work in college, there is a strong feeling that students should have some industrial experience prior to graduation. While it is true that many of them do, either in summer employment, apprenticeship, or on the coöperative plan, postwar planning undoubtedly will take into consideration the desirability of requiring a certain minimum amount of such experience before graduation. In this connection, it may be of interest to note that it has for long been the custom at the University of Glasgow for engineering students to spend half of each year as apprentices in engineering shops. The college course is planned with this in mind, extending over six fall and winter months. Although apprenticeship is not a requirement for graduation, it is otherwise virtually essential, a primary qualification for an engineering job in that part of the world being practical experience.

Faculty

Of all the thoughts expressed by the contributors to this report, probably the most recurrent and strongly emphasized is summarized in the statement, "Students are not taught by curricula but by men." The curriculum is no better or worse than the men who constitute the instruction staff.

One observer of engineering education is quoted as saying that the best teaching is being done by the assistant and associate professors who are still actively climbing upward. It is pointed out that if the mechanical engineering profession aspires to leadership in the scientific and manufacturing world, instructors, assistant professors, associate professors, professors and deans must be ever alert and constitute the leadership in new design, in creativeness and in management. They must never be satisfied to be mere loudspeakers of other men's contributions and discoveries. This implies that all mechanical engineering educators should spend intervals of active participation in industry if the greatest progress in engineering education is to be experienced. It implies further that engineering colleges should critically analyze their teaching personnel to determine whether each staff member is a potential and active leader in his field or has acquired an "arrived"

or "settled down" attitude under the protection of academic tenure.

The mechanical engineering profession can make its greatest contribution to postwar education by developing procedures, methods and standards by which every member of each teaching staff in mechanical engineering is encouraged to take and maintain an active leadership in his chosen field by research, advanced study, field experience and technical contributions of a high intellectual and scientific level.

To improve the quality of engineering graduates, there is some feeling that it is more essential to institute a plan of training of the teaching group rather than a continuous shifting of the subject being taught. Almost independent of the subject taught, a teacher of the right caliber can turn out men capable of absorbing additional training after graduation, and men fired with a desire to think constructively on the problems assigned them after graduation.

Three-quarters of a century ago Cornell's first president, Andrew D. White, recognized this when he wrote into the first general announcement, "Those professors will be sought who can stir enthusiasm and who can thus cause students to do far more than under a perfunctory, piecemeal study."

Several practical suggestions have been offered whereby students may have the benefit of industry-minded instructors. One of the leading machine tool building companies loans two of its analytical designers for a number of hours each week to take over classes in machine design at a nearby university. Where local conditions make this possible, great benefits result both to the students and to the designers who teach the courses.

Extending this idea, it might be practical to arrange for periodic exchanges between teachers and men in industry. From such an arrangement the college will derive a two-way benefit, one through the resulting contacts with men who are primarily industrially and practically minded, and the other through the broader outlook acquired by the permanent staff members. Where a cooperative plan can be put into effect, teachers as well as students may devote a period of several months each year to an industrial or other occupation which will increase their appreciation of the human and other problems which confront the engineer.

Teaching Methods

While the most important step in the improvement of teaching methods lies in the provision of the right kind of teachers, certain pedagogical practices are subject to criticism. It is pointed out that the primary objectives of engineering education are to teach students to think scientifically, to stimulate original thought, and above all to train them how to get things done. Under the present system, the student too frequently memorizes because the educational checking-up process is such that only a repetition of foregone conclusions is required. In line with this thought it has been suggested that examinations be of the "open book" type with students encouraged to utilize handbook material if necessary. The problems should call for the exercise of engineering judgment and grading should be more severe.

Reference to use of handbooks in examinations does not imply that the handbook should be the basis of engineering training. The student needs to be warned against the limitations

of the handbook. He should be taught the successive approximation approach to problems and should use the handbook or textbook more for checking after having developed his analysis by sound, logical and original thinking. Our best engineers are those who revert to basic fundamentals and build up their analyses on that viewpoint.

It is felt in some quarters that many textbooks lack the practical viewpoint. The manner in which engineering and design problems are attacked in industry often differs greatly from the theoretical engineering taught in the various schools. Greater use of text and reference material received fresh from industry should go a long way toward overcoming this objection.

Personal Development of the Student

Many comments were received concerning the intellectual and personal traits as developed through the entire educational process. It is pointed out that very few engineers lose out because they lack technical knowledge but many do because they have undesirable traits of personality or of character. One company reports that strictly technical engineers can readily be obtained, but that the man who has additional qualities such as personality and common sense is rare indeed. Students in mechanical engineering, particularly seniors, should be alert to the significant demand for those who have natural qualities of personality and knowledge of what it takes to be an executive.

Desirable traits should include the capacity for sustained intellectual effort and the ability to concentrate and to reason clearly to the best solution of a problem. With this ability should go the vision and judgment to foresee and prepare for both the probable and the possible solution of that problem. Furthermore, the graduate should have gained the ability to continue his intellectual development and should have acquired habits of reading and study which will insure that. Another essential is skill in expressing himself clearly in speech and writing for the interchange of ideas and information so necessary in modern business and as an aid to clarity of thought.

One criticism directed toward college graduates was the attitude with which they approached their various duties. This attitude is described as a mixture of (*a*) the desire to learn but refusal to admit ignorance, (*b*) a rather lackadaisical application to work and, in some cases (*c*) an objectionable amount of self-assurance. However, time automatically mellows this attitude and it is felt that nothing should be done to destroy the self-confidence of these men.

Another fault found with boys entering industry straight from college is their inability to operate in an organization. The experience is cited of a number of fine prospective engineers becoming confused and powerless because they could not overcome obstacles in the form of inadequate equipment, inadequate manpower, inconvenient facilities, organizational imperfections, and resistance of management to their particular project. They let seemingly insignificant things stop them, whereas if they had been more experienced and aggressive in the art of selling and promotion, they might have seen their ideas become a reality. Good technical training is eclipsed if the young engineer does not know how to make it effective, and it is suggested that more emphasis be

placed on teaching the students the art of getting things done. They should be taught to be more flexible in making the most of the tools at their disposal rather than expecting some preconceived, idealized, operational Utopia.

Comments were invited on the course content and teaching methods of three major mechanical engineering subjects—heat power, manufacturing processes and machine design.

Heat Power

Some heat power courses were criticized for their inclusion of so much work on steam. It is pointed out that emphasis on steam power plant engineering persisted long after the relative importance of this particular field had greatly diminished. Greater attention might be given to internal combustion engines and to developments such as the gas turbine and jet propulsion.

It is also believed that the possibilities of laboratory instruction for giving the students some "feel" of machinery could be more fully exploited. Hitherto code testing has received most of the attention and it is felt that instruction of the demonstration type also should be given. This would include instruction covering the component parts of the machine, the various mechanisms and their function, the controls and their action, and the operation and maintenance of the machine. Some of this work, including the sketching of the various parts, should be given prior to the theoretical heat power course.

Manufacturing Processes

Opinion seems to be unanimous that the old type of practical shop course which teaches merely routine machine operation and skill, has no place in an engineering course. Much of the content of such a course should, if possible, be obtained from actual experience in industry. Furthermore, there is a strong possibility that some of the tremendous excess supply of machine tools after the war will be distributed to both secondary schools and colleges. As a result, there will be much better training in shop processes available to the high school students and it may then be desirable to place the responsibility for this training on the secondary schools.

In place of the old-style shop course, it is generally agreed that attention should be devoted to the engineering problems of interchangeable manufacture and up-to-the-minute production processes. More emphasis should be placed on the properties, uses, and methods of fabrication of engineering materials and the groundwork laid for subsequent courses in machine design, inasmuch as manufacturing processes affect the design of machine parts.

Of unusual interest is a proposal to set up production laboratories in which each student would spend three hours a week throughout the sophomore, junior and senior year. The sophomores would run the machines, studying the problems facing the operator, the effect of machine down time on production, making out reports on metal-working costs and gaining an appreciation of the value of proper tooling. The juniors would be the subordinate supervisory personnel and it would be their duty to take care of the machine set-up, movement of stock, trouble shooting, records for stock and production, and to develop programs for workmen's safety, morale building, and improvement of efficiency. The se-

niors, who by that time would be studying industrial plants, methods engineering and management, would use the shop as the laboratory for their courses and would do the planning for product change over, retooling, revisions in methods and other major changes. It is pointed out that such a series of courses if properly coördinated would provide training which is pervasive through all industry.

Machine Design

Extensive viewpoints were received concerning courses in machine design, the consensus being that a broader view is needed. Many courses are highly formalized solutions of specific problems in strength of materials and kinematics, and more emphasis is needed on simplicity of design, first cost, ease of repair, safety of operation, and methods of control. In most machine design courses, too, primary attention seems to be given to machinery of the heavier types. In recent years, high-capacity, high-speed and lightweight machinery and mechanisms have come to the fore and an era of complex lightweight control mechanisms seems to be at hand. Even in such devices as the electronic tube there are mechanical development problems that were hardly conceived of a few years ago.

It is felt that in machine design as in other courses, emphasis should be placed on fundamentals because students must learn to use the mechanics and strength of materials that they have been studying during the previous years. Empirical rules should be few and attention should forever be concentrated on the reasons behind these rules.

It is also suggested that there is need for a greater appreciation of the analytical approach to machine development and design problems. This suggestion derives from the feeling that too much attention has been given to the routine designing of a standard piece of equipment such as a punch press or triplex pump. It is felt, for example, that much might be gained by giving a student a problem involving several hand operations and letting him work out a practical mechanization of such operations.

The trend is all toward more accurate analyses and design with smaller safety factors and lighter weight. Weight will be an important factor in most design, for shipment of parts and machines by airplane. Also, machine design courses will have to give continued and increasing attention to problems attendant to high-speed machinery—inertia forces, vibrations, concentrated stresses, dynamic loading, and failure under repeated stresses. Generous amounts of time for problem solutions will be necessary and as a consequence, extensive detailed design of common parts will probably suffer.

Along with more rational design based on fundamentals, increased use can be made of experimental methods in classroom demonstrations and laboratory. The facilities now available in photo-elasticity, electric strain gages and brittle lacquers lend themselves admirably to convincing expositions of stress concentration, combined stress phenomena and a large variety of dynamic effects as well as the simpler stress-strain relationships.

Too often a student feels that a development which includes considerable mathematical computation is exact. A suitable experimental check could quickly reveal several flies in the ointment and give the student a means of evaluating the accuracy of a number

of possible methods of analyzing the same problems.

The criticism is made that many machine design courses are devoted too exclusively to the design of types of machines requiring highly theoretical treatment. Actually a large number of mechanical engineers in design work depend more on engineering judgment than on highly theoretical calculations. Ingenuity in deciding on the best design from the standpoint of efficient manufacture and convenient trouble-free use is particularly important. In some industries the effects of temperature, humidity and altitude on performance of materials, the effects of vibration and shock on small parts, and the suppression or accurate transmission of vibration are more important than are calculations of stresses and strains.

Another aspect of machine design might be considered for college courses. In practically all design work there are limitations set by former work or design. Seldom does a designer start with a clean sheet of paper. He is most often working on a redesign, trying to use tools already built, trying to keep within the capacity of shop machine tool equipment. It is suggested that students be given some experience on this work and given a chance to see how designers have laid out existing mechanisms. Typical suggested problems are: Redesign of a control linkage to use plain bearings instead of ball bearings; redesign of a spring for the cross slide of a screw machine, the old spring having failed in fatigue; and redesign of a speed reducer for another speed ratio with the minimum amount of change in the overall design.

Another subject which it is felt should be given more emphasis in machine design courses is tool engineering and tool design. Because of their importance in mass production manufacture some time spent on the design of punches, dies and fixtures would appear to be justified. The war effort and the E.S.M.W.T. courses have shown the importance of this type of training.

The usual complaint that the majority of college graduates lack sufficient experience in drafting and in lettering is heard again. Those in industry feel that this should not be a major part of their on-the-job training. As a result of war experiences, it is felt that further developments will take place in the field of drawing that relates to the perspective and isometric illustrations that have become so popular in aircraft production—Production Illustration. In the teaching of elementary design and drafting it is suggested that more use of clay models might be advantageous.

It is urged that in courses such as machine design, greater attention should be given to the development of inventiveness on the part of our students. The future of this country, in fact of the world, depends upon creative people, people who have the ability to develop new devices and new processes to add to human comfort and happiness. We have been exceedingly unwise in not capitalizing our opportunities to develop inventiveness on the part of our students. In fact, it is suggested that the student start a problem or a project at the beginning of the second year, and carry it out for at least three years, with the idea of developing his creative instinct.

Conclusion

In conclusion, acknowledgment is again made of the assistance of the

men in colleges and in industry who contributed their views to this report. It is hoped that this paper, which attempts to present a summary of their thoughts, will prove of value to the teaching profession in laying plans for mechanical engineering education after the war. Names of those who cooperated follow:

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Army Training Methods Enter the Engineering College

By KENNETH A. KOBE

Professor of Chemical Engineering, University of Texas

The "problem" of the returned veteran is now provoking considerable discussion on all campuses. Special courses, particularly of the "refresher" variety, are proposed, and special advisory services, special housing, etc., all are suggested to assist the returned veteran in rapidly adjusting himself to the routine of university training. The problem looms large in the future of the college of engineering in the post-war period. The soldier or sailor has chiefly been concerned with practical operation of many kinds of equipment, as aviation, radar, diesel and electric power, signal, automotive, chemical, etc., and wishes to augment his practical experience with the necessary theoretical background through his allotted university training. For this reason, many veterans will enroll in the college of engineering.

What G. I. Joe Has Been Used to

Three groups will present themselves to the college for education under the G. I. Bill of Rights. Even now they are beginning to come. The first group has completed high school but has had no previous college training; the second group completed part of its college training before entering the military service; and the third group has already graduated from the college but desires "refresher" courses to bring back into working condition those engineering principles and methods unused and forgotten during the years of military service.

For the first group, which knows nothing of college life, special orientation is necessary to insure the proper start. In the army everything is done for the soldier with respect to supply and equipment, and it is expected that the Veteran's Bureau or other governmental agency will continue this practice. Knowing nothing of college training methods, the first group will be most critical in their comparison of the college and army methods of teaching. Those having some previous college training may welcome the return to the laxness of college methods. Both groups, however, are now becoming more mature; they will want something definite, and certainly those in the college of engineering will want something utilitarian enough to fit into the scheme of earning a living in the post-war era.

In dealing with such students it is to be remembered that in the army training program the daily schedule of classes was arranged so that maximum interest could be maintained. Physical exercise came early in the morning; lecture or training films were not given immediately after dinner; activity followed a period of inactivity—these were some of the rules on which the training schedule was based. Such a

program will inevitably invite comparison with that of the college, where the student fills his schedule from a fixed program of classes, usually not to the best utilization of his time or stimulation of his interest in the subject. Furthermore, in the army, each individual was under supervision at all times during the training periods. Assistance was plentiful, and the non-commissioned officers were expected to give the necessary attention to the individual so that he would progress at the same rate as the rest of the group. The slower learners were given additional instruction on their own time, as individual instruction from their N.C.O., or additional classes held in the evening by a company officer. The army instructor is not expected to fail ten per cent of his class; rather, he must bring all of them up to at least a minimum standard of performance. His rating as an officer depends on his ability to do so. All this is foreign to the conventions of college teaching.

Objectives of Military Training

The ultimate objective of all military training is the assurance of victory in battle through offensive action. Successful offensive action demands that military training develop in the individual the following qualities:

Morale
Discipline
Health
Technical Proficiency
Initiative
Adaptability
Leadership
Teamwork
Tactical Proficiency

The college instructor is too frequently satisfied with his results when his trainee shows technical proficiency. The college program too frequently leaves to the fraternity or extra-curricular activities the training in these other important objectives. The college should consider methods of giving greater breadth to their training program.

Incentives to the Soldier

What incentives are used to induce the soldier to learn and apply the wide variety of subjects presented? As always, the personality and vitality of the instructor is the chief incentive to learning. The use of the introductory phrase, "Your *life* may depend on how well you learn this," followed by an illustrative anecdote, will motivate many individuals who react but little to other stimuli. The desire to achieve the rating of a non-commissioned officer will stimulate the above-average soldier, whereas the below-average man may be stimulated by the reminder that extra training is given the laggard until he attains the minimum degree of proficiency. "Remember, the pass is a privilege, not a right!" is an army slogan that induces many a soldier to work for his Saturday night pass. Extra duty and company punishment are awarded the shirker.

Differences Between Army and College Training

Training in the army during war time is reduced to those subjects and skills essential to the objective of the training. As shown in Fig. I, such training is reduced largely to skills and procedures, with only enough of the principles to serve as a basis for the other two. The instructor further reduces his material in accordance with the "Must Know" criterion shown in Fig. II. These principles are considerably different from those of the col-

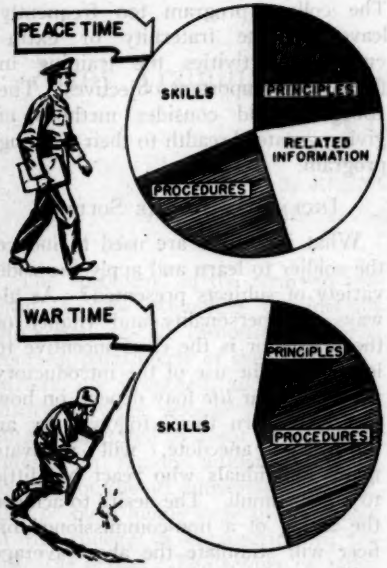

FIG. I. Army training.

lege, though it must be realized that they are based on the army rule of complete training in six months, whereas the college isn't sure it can do the job in four years. However, the difference between the two types of training is the difference between *doing* and *thinking*. The college aim is to turn out an engineer who can *think*, whereas the man who can only perform certain skills is relegated to the role of engineer's aid.

But in spite of these different objectives, the man entering the college after a period of army training will compare the college training with his army training and be prone to expect his progress toward becoming an engineer will be as rapid as that toward becoming a trained soldier. He will be impatient with the slowness of the process of education as compared with training. He will contrast the methods of the instructor and be impatient with the "well to know" or even "interesting" information now introduced. In comparing the college instructor with the army instructor, he will note the lack of training films, film strips and slides, charts, and other training aids (Fig. III) used so abundantly in the army. Most of all, he will be impatient and critical if the material is not "practical"; and the college instructor continually must point out the value and applications of the principles and methods of thinking to which the student is being subjected. This undoubtedly will be the greatest problem faced by the college instructor teaching returned veterans.

In the army, incentives were used to speed the learning process. What can the college instructor use as an incentive? Now the phrase, "Your *job* may depend on how well you learn this," may be substituted, but it is doubtful if much stimulation can be induced with it. The job is too far away and too nebulous to compare with the man's life. Should not some consideration be given to additional classes which might parallel the extra training given in the army? Should the college leave this to the paid tutor-

HOW MUCH WILL BE TAUGHT

FIG. II. The army instructor's bulls-eye.

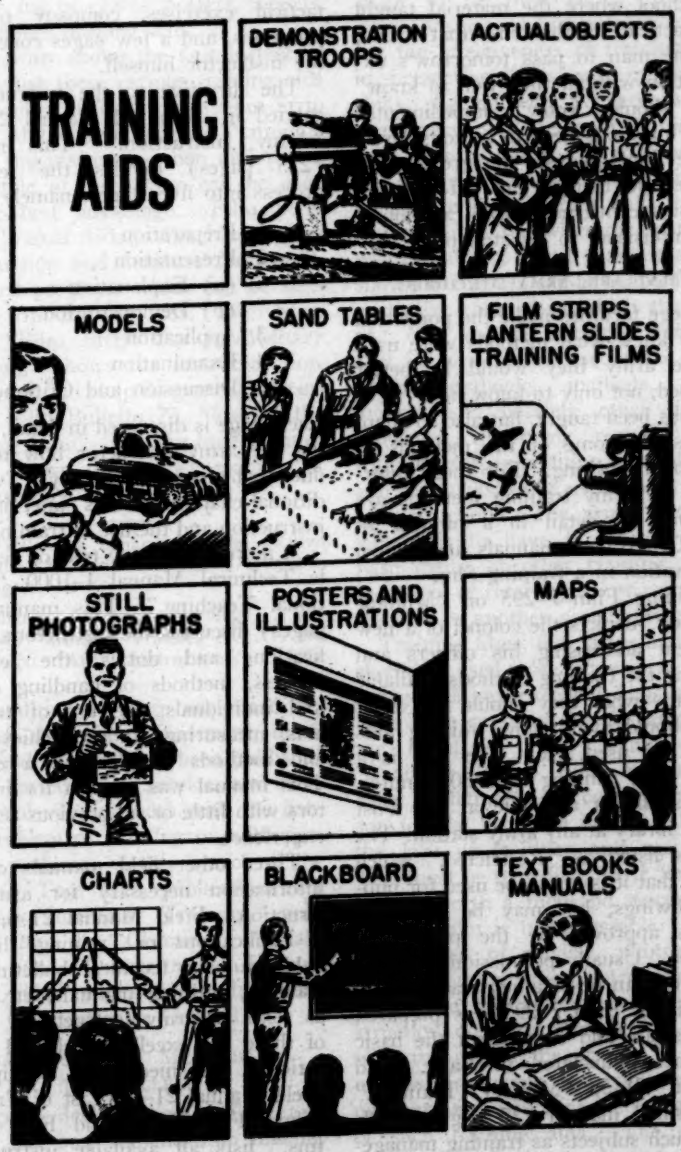

FIG. III. Army training aids.

ing school where the material taught is "practical" in the sense that it enables the man to pass tomorrow's examination without the "well to know" and "should know" impediments? These questions need to be considered. In the final analysis the greatest incentive the college can offer is an enthusiastic instructor who can impart this enthusiasm to his students.

What are Army Methods?

College faculties make the point that if they knew what methods were used by the army they would be better equipped, not only to know how "G. I. Joe" has been taught, but also to adapt successfully some of the methods to their own teaching. For those interested, the army training methods are explained in detail in a number of War Department manuals and shown in operation in a training film.

Training Film 7–295 on "Military Training" depicts the colonel of a new regiment addressing his officers and showing the training methods available to them—what they should do, what they should avoid, how training aids should be used, etc. The film is a sound film, running time 50 minutes, and usually is available at the Post Film Library at any army station. The film is listed as "Restricted," which means that it is not to be used for public showings, but may be used for groups approved by the post commander. Usually permission for such showings can be obtained readily.

Training Film 7–295 was prepared to illustrate and supplement the basic doctrines enunciated in Basic Field Manual 21–5, "Military Training." This small manual (75 pages) deals with such subjects as training management, means and scope of training, training of individuals, unit training, tactical exercises, company training programs, and a few pages concerning the instructor himself.

The directive to the instructor is carried in Technical Manual 21–250, "Army Instruction." This manual (225 pages) divides the teaching process into five stages, namely:

1. Preparation
2. Presentation
   (*a*) Explanation
   (*b*) Demonstration
3. Application
4. Examination
5. Discussion and Critique

Each stage is discussed in detail, showing the army instructor how to conduct that phase successfully. Two additional chapters discuss supervision of instruction and the use of training aids.

A more elementary text on teaching is Technical Manual 1–1000, "Vocational Teaching." This manual (77 pages) discusses the instructor's qualifications and duties, the learning process, methods of handling classes and individuals, the use of training aids, measuring student achievement, and methods of planning a course. This manual was written for instructors with little or no previous teaching experience.

Three other field manuals contain information necessary for army instruction. Field Manual 21–6, "List of Publications for Training," lists all field manuals, technical bulletins and manuals, training manuals, etc., used as texts in army instruction. Many of these are excellent technical publications on mechanical equipment. Field Manual 21–7, "List of Training Films, Film Strips and Film Bulletins," lists all available instructional material of this type. Field Manual 21–8, "Military Training Aids," pro-

vides a list of charts, posters, models, and similar training aids.

The army shows the new instructor how to use these various training aids in a number of film strips. Film Strip 8-43, "Methods of Military Training," shows the instructor when and where each style of instruction can be used to the best advantage. Film Strip 7-75, "Visual Aids to Teaching," gives a discussion and demonstration of illustrated problems which can be simplified with training aids. Film Strip 21-1, "Film Strip Use in Military Training," shows the instructor how to use the film strip to greatest advantage. Film Bulletin 73, "Use of the Training Film" (running time 15 minutes), shows the proper manner of using training films.

The following manuals can be secured from the Superintendent of Documents, Washington, D. C.:

TM 1-1000, "Vocational Teaching".... 15¢
FM 21-5, "Military Training"..... 15¢
TM 21-250, "Army Instruction"..... 30¢

In addition to these various directives of the War Department, much additional material has been published by the various army services and service schools dealing both with the general problem of training or with particular problems of that branch of the service. Two such publications are "Military Instructor Training," published by the Chemical Warfare School, and "Quartermaster Instructor's Guide," published by the Office of the Quartermaster General.

Adapting Army Methods to the College

A great deal of time, effort, and money has been expended in making the army's training as effective as possible. Certainly the college desires to adapt to its own needs everything which has proved successful in increasing the effectiveness of training, both in presenting ideas and in teaching skills. Undoubtedly the largest factor in the success of the rapid training has been *training aids*. The continual cry has been for more and better training aids, more and different ways that the trainee could *see* what the instructor was explaining. Such training aids as shown in Fig. III can be adapted to the particular courses in which they best fit. The college instructor may say that he now makes use of the blackboard, textbooks, manuals, charts, models, and possibly other devices. However, the army requires these training aids, in addition to blackboard and textbooks, to be used *every* period of instruction! The army instructor who fails to have his model, chart, flash cards, or other training aid, is in danger of receiving a low rating and transfer to another assignment.

Training films, film strips and slides should be used more extensively by the college. Many excellent films already have been prepared by the army and are listed in Field Manual 21-7, "Training Films, Film Strips, and Film Bulletins." Of course, the reason for the little use in the college is the lack of facilities and assistance. This must be remedied, for if "one picture is worth a thousand words," the training film is unsurpassable.

The use of models, photographs, charts, diagrammatic illustrations, flash cards, and similar aids in college instruction does not compare in extent with the use in the army. It is the unusual instructor who will use his own time and effort for the preparation of such training aids. The college does not supply the necessary facilities, other than the departmental shop.

Poster cloth, various colored paints, layout tables, and other needed equipment are not available unless an unusual effort is made to secure them. The college instructor is usually too interested in other things to spend his free time preparing training aids for every class period. He is more interested in his research, his forthcoming book, his "Victory Garden," or similar activity. After all, the instructor is doing the same as old Professor Phizz, and *he* got a professorship, didn't he?

Summary

"G. I. Joe" has been used to an army training that presents *practical* material in an interesting manner with a profuse use of visual methods and training aids. He will expect his college training to be practical and to be presented effectively with the use of training aids. The college should survey its courses and its facilities with a view towards extending the use of training films, strips, and slides, as well as the more usual training aids.

T M 21–250 on "Army Instruction" is introduced with a quotation from Under Secretary of War Patterson: "The ideal officer is not afraid of anything—not even a new idea." Let us hope the college professor can compare in boldness!

College Credits for In-Service Courses*

Inquiries made of twenty-two engineering colleges as to their practices in awarding credits for in-service courses elicited twenty replies from which the appended summary is made. There were significant observations in many cases, as well as several schedules of actual credit evaluations. Enough of these latter are tabulated to indicate that the range of non-uniformity which exists is not great. Credits allowed by nine engineering colleges are shown in the accompanying table. No one college gave all of the courses listed but parallel columns allow comparison where two schools gave the same subject. Note that three of the columns show Quarter-Credits, while six are in Semester Credits.

From the comments made by the officials who replied, we may report certain definite attitudes and procedures.

It is evident in nearly all replies that the colleges are recording all the credit they can reasonably, whether or not the hours are usable toward the specific degree which that college awards.

University of Illinois	Sem. Cr. = (C + 1/3 L)2/3
New York University	Sem. Cr. = 1/3(C + L + P)3/4
Case	Sem. Cr. = (Qr. Cred.)3/4
University of Nebraska	Sem. Cr. = (C + 1/3 L)2/3
Pennsylvania State College	Sem. Cr. = 1/3(2 C + L)3/4
Purdue	Sem. Cr. = (C + 1/3 L)3/4
University of Pittsburgh	Sem. Cr. = (Qr. Cred.)3/4

This is done as a matter of equity so that the credit becomes available for the student to use elsewhere if his plan develops best that way.

In general, the Navy College Training Program is recognized as being so closely parallel to regular engineering curricula and its time schedule so satisfactory that full credit is allowed as a matter of course. If completed, these curricula are acceptable as a basis upon which to award degrees. Partial completion of the curricula still carries credit which may be applied in every particular as civilian credits can be used.

With A.S.T.P., the case is different, inasmuch as the objectives of the several curricula are so much more limited and specific. It has been necessary for college authorities to examine these programs, course by course, and estimate the value of the training of each. This usually has been done upon the same basis of evaluation as that which is used for civilian work. In fact several colleges gave formulas for evaluation, in terms of class hours (C), laboratory hours (L), and in some cases preparation hours (P). For example:

It will be observed, however, that some institutions use the fraction three-quarters and some two-thirds as a reduction factor between quarter-credits and semester-credits.

Tables of the results of these cal-

*Committee 1944-45—O. J. Ferguson, *Chairman*, H. A. Fisher, D. B. Prentice.

culations are prepared by many of the colleges in great detail. The tables are published in some cases, accompanied by a brief description of each course given, its value in credits, and even the schedule of the application of the credit in terms of the college's own courses or curricula. These schedules are very useful both locally and in cases of transfer of credits to other colleges.

The American Council on Education Guide to Credit Evaluation is almost universally used and very cordially commended for its helpful analyses. Of fifty-two inquiries made as to this usage 43 replies have been received with tabular results as follows:

1. Are you using the A.C.E. Guide on Evaluation of Service Credits? Yes—42. No—1.

2. Do you find it satisfactory? Yes—41 (including Qualified—8). No—1.

Comments upon this service are almost entirely commendatory. Even the criticisms relate largely to its incompleteness, which is not a surprising feature, considering the magnitude of the list of training courses offered by the several branches of service.

It must be recalled too that, inclusive as it is, there is an announced limitation to the area for which the Guide was planned. Specifically, courses given under the A.S.T. and V-12 programs were not to be included. These were left to the faculties themselves to evaluate, precisely as any other civilian-taught college courses are recognized by credits. S.P.E.E. endeavored to guide thinking in such matters by a committee recommendation published in November, 1943 (JOURNAL OF ENGINEERING EDUCATION, Vol. 43, No. 3, pp. 296–297).

Referring to the A.C.E. Guide, one college says, "Not exactly satisfactory. Very helpful in giving information . . . but we find their recommendations to be somewhat more liberal than our policies permit in many cases."

In some instances a college requires completion of two terms of a course before giving any credit (Geography 163, History 133, Chemistry 205–206).

The indexing system is not considered very handy.

Several colleges express the view (which the Council presumed all would take) that the recommendations of the Guide are accepted as advisory and are administered in the light of local experiences and judgments, which are supplemented by examinations when such are considered helpful. This is as it should be. The local college should recognize its final responsibility and authority.

The A.C.E. Guide evaluates the credits suitable for courses as outlined but makes no attempt to measure the performance of the individual student. The giving of examinations either by the utilizing college or by U.S.A.F.I. may be necessary to establish the record.

Some 9,000 copies of the Guide are in the hands of the Army and the Navy, practically wherever troops are stationed. These may be used as sources of information to which service men may be referred in all correspondence concerning courses and credits.

The Guide Committee is now working upon the evaluation of credits for courses given in the U. S. Maritime Service. Results of these studies will be available by fall.

Whether or not post-hostilities instruction can be covered in later recommendations is yet to be decided.

It is the purpose of this second report of the S.P.E.E. Committee on

Credits Allowed for In-Service Courses

In Semester Hours (Cornell, K.S.C., Mich., Nebr., Penn State, Purdue)
In Quarter Hours (Ohio S. U., Ia. State Coll., Maine)

	Cornell U.	K.S.C.	Mich. U.	Nebr. U.	Penn. State	Purdue	Ohio	I.S.C.	Me.
Chem.									
61—Genl.		2		2		3	4		4
62—Genl.				2		3	4		4
125—Quant. Anal.				2					
126—Quant. Anal.				2⅔			3		
205—Basic	2	2		} 3			3	3	3
206—Basic	3	3					4	3	4
211—Qual. Anal.	4			3			5		
261—Organic	4.5			2⅔			5		
262—Organic	4.5			2⅔			5		
Chem. Eng'g									
335—Thermodyn.			2				3		
401—Qual. Anal.							4		
402—Quant. Anal.							4		
403—Calculations			2				3		
403—Ph. Ch. Lab.			2⅓						
404—Physical							4		
405—Organic							9		
406—Chem. Tech.			2				4		
410—Phys'l Metal.			2				3		
415—Unit Op.			2				4		
416—Unit Op. II			2				2		
417—Unit Op. Lab. I			2				3		
418—Unit Op. Lab. II			2				3		
420—Chem. E. Probs.			3				4		
Geography									
11—		2⅔		2					2
31–71		—		2–2		2–3	5		
163a—Physical	1	1⅓		2			2	2	2
163b—Economic	1	1⅓		2			2	2	2
163c—Political	1	1⅓		0			2		1
163d—Military		—		2					
History									
11–61—Am. 1865–date		2⅔		2–2		2–3	4–4		4–4
31–71—Am. 1865–date				3–3			5–5		
133a—American	2	2		1			}	3	}
133b—American	1	1⅓		1			} 5	3	} 5
133c—American	1	1⅓		1			}		}
133d—American	—	—		2					
Eng'g—Civil									
008—Surveying—Topog.		2⅓							
078—Surveying—Plane		2							
403—Foundations		2⅔	3		2½		4		
403—Struct. Des.		3	3				4		
403—Transportation		2⅔	3		2½		5		

CREDITS ALLOWED FOR IN-SERVICE COURSES—*Continued*

	Cornell U.	K.S.C.	Mich. U.	Nebr. U.	Penn. State	Purdue	Ohio	I.S.C.	Me.
Eng'g—Civil—Cont.									
403—Wat. Sup. & Sew.		2⅔	3		2½		4		
407—Surveying		2	2	2			4		4
408—Surveying Adv.				2					3
408—Struct. Dftg.		⅔	1	0			1		3
409—Surv., Pl., Top., & Map'g		⅔	1	5			1		
413—Stress Anal.		2	2	2			5		3
420—Theory of Struc.				2					
518—Stress Anal.					2½		5		
523—Struc. Design		3			2½				
602—Survey., Adv.					2		3		
618—Theory Str., Adv.		3					4		
Eng'g—Electrical									
401—Elem. Elec. Eng.		3	4	4	3		6		4½
403—Elec. Meas.		1⅓	3	2	1½		3		3
405—Elec. & Mag. Phenom.		4	4	4	3½				6¾
409—D. C. Machinery		3	3	3	2½		5		4½
410—A. C. Machinery		4	4	4	3½		5		
414—Elec. Circ.		4⅔	4	5	4		7		9
415—Elec. & Assoc. Circ.		4⅔	5	5	4		6		
416—Elec. Circ.—Transients		2	2				4		
417—Elec. Circ.—Distrib. Const.		2	2				3		
420—H.F. & U.H.F. Circ.		5⅓	5		4½		8		
422—Com. Networks		2⅔	3		2½		4		
424—Servo.—Mech.		2⅔	3				4		
426—Rad'n & Prop'gn		2	2				3		
429—Servo.—Mech.		4			3½				
435—Teleph. Circ. & Equipt.		4		3	3½				
Eng'g—Mechl.									
326—Mech. & Pwr. Transm.		2		3			2		3
336—I. C. Engines				3					
401—I. C. Engines		3⅓							
401—Thermo.		3⅓	3	3⅓	2½		5		5
405—I. C. Engines		2⅔	3	3	2½		3		4.5
406—Shop Practice		1⅓		1	1½				2
406A—Shop Practice		⅔	1	⅔	1				.5
410—I. C. Engines			4	3	3		6		6
411—I. C. Eng. Lab.			1	1⅓	1		3		
420—Mech'l Lab.		⅔	1	⅔	1		4		1.5
430—Metallog. & Ht. Treat.			2	2⅓					4
469—Applied Thermo.				2					
470—Heat Pwr. Eng.				3⅓					
524—Adv. Mech. Lab.				⅔					
Mechanics									
401—Fluid Mech.		2⅔	3	3	2		3		4

CREDITS ALLOWED FOR IN-SERVICE COURSES—*Continued*

	Cornell U.	K.S.C.	Mich. U.	Nebr. U.	Penn. State	Purdue	Ohio	I.S.C.	Me.
Mechanics—Cont.									
401—Matls. Test. Lab.		⅔	1	⅔	1		1		1
401—Statics & Dynam.		4	4	4	3		7		6
401—Strength Matls.		2⅔	3	2⅔	2		4		4
402—Kinematics		3		2⅔	2½		4		4
408—Machine Design			4	3	3		3		
410—Mechl. Vibrations			2	2			3		
471—Properties of Matls.		2⅓			2				
525—Fluid Mech. Lab.		2							
526—Mech. of Concrete		2⅔							
527—Mech. of Wood		2							
619—Constr. Matls.		2⅓							
Mathematics									
11—H.S. Math.				0	0				
12—Alg. & Trig.				3		2	3		
61—Alg. & Trig.		4		4		3	5		
62—Analyt. Geom.				3		3	4		
63—Analyt. G. & Calc.				4			5		
306—Spherical Trig.				3					
401—Integ. Calc.		3⅓	4	3	2½		5	4	5
401D—Dif. Equations				3					
403—Engineering Math.		2	2	2	1½		3		3
406—Alg. & Trig.	4	4	3	4			6	5	6
407—Analyt. Geom.	3	3⅓	4	3			5	5	5
408—Dif. Calculus	4	3⅓	4	3			5	4	5
English									
11—Comp.		2		1		1	3		
12—Comp.				1		1	3		
13—Comp.				1½			3		
61—Comp.		2		1		2	3		
63—Comp.				1½		2	3		
111a—Composition	2	2		1			3	3	
111b—Written and Oral	1	2		1			2	3	6
111c—Read., Writ. & Mil. Cor.	1	1⅓		1			2	3	
112—Lit.				1			2		
113—Lit.				1					
Economics									
1—Principles				2					
2—Principles				2					
Engineering Problems									
31—Tech'l Problems				2					
61—Eng'g Problems				1½					
Engineering Drafting									
001—E. Dwg.	2	2	2½	1⅓			4		3
11-61—E. Dwg.				1⅓			4		
406—E. Dwg.		1	1½	1	1		6		2
409—Topog. Dftg.				⅔					

CREDITS ALLOWED FOR IN-SERVICE COURSES—*Continued*

	Cornell U.	K.S.C.	Mich. U.	Nebr. U.	Penn. State	Purdue	Ohio	I.S.C.	Me.
Physics									
11—				2		2			
12—				2⅔		2			
13—				2⅓					
61—Mech. & Sd.		3⅓		3⅓		3	5		4.5
62—Ht. & Lt.				3⅓		3	5		4.5
63—Mag. & Elec.				1⅔			5		4.5
303—Elec. & Mag.							5		5.5
304—Mechanics.	3	3⅓	3	3⅓			5	5	5.5
305—Sd., Ht., Lt.	3	3⅓	3	3⅓			5	5	5.5
306—Elec. & Mag.	3	3⅓	3	3⅓			4	5	5.5

Credit for In-Service Study to provide a statement of procedures generally followed by engineering colleges, with a few examples of typical results. While we recognize that the great task involved in the use of these credit-records is yet to come, we believe that by foresight and planning the colleges have reduced the drudgery necessary to the accomplishment of the job, with a good outlook for results that will be fairly satisfactory and uniform.

S.P.E.E. Committee on Engineering Economy in Retrospect*

By PAUL T. NORTON, JR.

Professor of Industrial Engineering, Virginia Polytechnic Institute

The S.P.E.E. Committee on Engineering Economy was created by Council during the 1936 Annual Meeting, but the man really responsible for the committee is William E. Wickenden, who, as President of S.P.E.E., suggested that a joint conference on the teaching of engineering economy be held during the 1934 Annual Meeting. President Wickenden's letters of March 17, 1934, to the chairmen of the committees on civil, electrical, industrial and mechanical engineering, included the following paragraph:

> I am writing to inquire if the four committees on civil, electrical, industrial and mechanical engineering might not be interested in jointly sponsoring a conference on the teaching of engineering economy with particular reference to a larger introduction of these considerations into the engineering subjects of the senior year. It might be a marked advantage to have the four departmental viewpoints represented with some chance for a breakdown into separate groups in each of the four fields.

In spite of the active interest of all four committee chairmen in organizing such a joint conference, it was found impossible to select a time for the conference which would not conflict with other conferences on strictly technical subjects. In fact, the program for the 1934 Annual Meeting indicates that there were some thirteen other conferences scheduled at the same time as this joint conference, including at least one conference on a subject of particular interest to members of each of the four coöperating groups. The attendance at the conference was very small but the discussion was, to put it mildly, very vigorous and quite typical of succeeding conferences in that no two persons present seemed to be in agreement either as to what engineering economy really was or how it should be taught to engineering students. A report of the conference may be found on page 141 of the October, 1934, issue of THE JOURNAL OF ENGINEERING EDUCATION.

While there was no formal committee until after the 1936 annual meeting, there were joint conferences on engineering economy at both the 1935 and 1936 annual meetings, the 1935 conference being sponsored by the industrial and mechanical engineering groups, and the 1936 conference being sponsored by the chemical, civil, electrical, industrial, mechanical, mining and metallurgy, and coöperative engineering education groups.

E. L. Grant was chairman of the

* Presented at the 52nd annual meeting, S.P.E.E. (Engineering Economy), Cincinnati, June 22–25, 1944.

committee during the first four years of its formal existence and E. D. Ayres has been chairman during the past four years. It would seem that the chairmanship of the committee should be a rather easy task, because all engineering teachers agree that engineering economy should be accorded an important place in all engineering curricula. Unfortunately, agreement ends at that point, and after having observed the discussions of engineering economy which have taken place during the past ten years, I can only say that I marvel that Professors Grant and Ayres have been able to do as well as they have in defining the subject itself and in keeping the conference discussions fairly well in line with this definition.

In addition to the conferences at S.P.E.E. annual meetings, the committee acted as one of the sponsors of two very successful conferences on economics which were held at Stevens Engineering Camp, Johnsonburg, New Jersey, in 1936 and 1937. While these two conferences, and also the very successful S.P.E.E. Summer Session held on the Stevens Campus in Hoboken in 1932, carried the name Economics rather than Engineering Economy, a very large part of the program of all three of them was devoted to what most of us would call engineering economy. I hope that more of these longer conferences can be arranged during the immediate post-war period, when problems of this sort will be so important and so difficult to solve.

The committee has also made a real contribution to the cause through the Engineering Economy Pages which were published in the JOURNAL several times a year, beginning in the issue of May, 1937, and for a number of years thereafter. These made it possible to bring to all members of the Society discussions of those matters about which it has been so difficult to reach any sort of agreement.

With the exception of the Texas meeting of 1938, there have been conferences on engineering economy at every annual meeting since 1934, and they seem to have become a regular and permanent part of the annual meeting program. Unfortunately, we are still plagued with the conflict difficulty, and there are actually fourteen other groups with something definitely listed on the program tonight. While all engineering teachers admit freely that engineering economy is an essential part of all engineering curricula, there are few members of the Society who seem to feel that a conference on this subject is important enough for them to choose it in place of a conflicting conference in their particular field of engineering. It seems to me that this subject is such an important one that it should be discussed either at one of the general sessions or preferably at a conference scheduled at a time when there were no conflicts with subjects that could possibly be of interest to those who should attend a conference on engineering economy. It seems to me that it would be much better to have discussions of the subject only every three or four years than to attempt to continue the present method with the attendance so greatly reduced by the conflicts with other conferences.

Mechanics Division

The results of our election to the Executive Committee show that P. W. Ott of Ohio State University and J. W. Howe of Iowa University are the two new members to serve until 1949.

The following constitute the present executive committee. The dates show expiration of term of office.

S. Fairman, 1946, Purdue University
M. O. Withey, 1946, University of Wisconsin
C. O. Harris, 1947, Illinois Institute of Technology
W. E. Wilson, 1947, Armour Research Foundation
R. V. James, 1948, University of Oklahoma
C. W. Muhlenbruch, 1948, Carnegie Institute of Technology
J. W. Howe, 1949, University of Iowa
P. W. Ott, 1949, Ohio State University.

By a vote of the Executive Committee Professor C. O. Harris has been elected Chairman of the Division for 1946.

I wish to express my thanks for the generous cooperation of the Executive Committee as well as to others who have helped me so much during my term as chairman. I know this spirit of cooperation will be extended to our new chairman.

SEIBERT FAIRMAN,
Retiring Chairman,
Mechanics Division, S.P.E.E.

At this time when sectional and national meetings cannot be held, the Executive Committee of the Division might, as one of its functions, serve as a clearing house for information of activities in Mechanics. I am told that we may have one page in the JOURNAL each month and activities can be reported briefly here.

Recent industrial and collegiate developments indicate that, in addition to operation as a service department, there is need for a program of study in Mechanics, especially in the graduate field. Probably many colleges are taking advantage of this period of lowered enrollment to reexamine their work, and a summary of the findings of each would be useful to the others.

Every instructor has his own pet problems, each formulated to bring out a certain point in Mechanics. Inclusion of a few such problems will add interest to our page.

If members of the Division will send such material to me, along with other notes of interest, I will undertake to gather it together and transmit it to the editor of the JOURNAL.

CHARLES O. HARRIS,
Incoming Chairman,
Mechanics Division

Physics Column

By JAMES G. POTTER, *Chairman*

In the absence of the annual meeting of S.P.E.E. a Physics Column in the JOURNAL will be of service in exchanging news of physics departments concerned with engineering education. The column can serve a definite need in making available information on activities and findings of the various physics departments in such matters as the introduction of new courses and curricula, the reapportionment of time allotted to physics courses in various curricula, the offering of scholarships and fellowships, manpower needs, evidences of demands for individuals with special training in physics, the obtaining and development of new equipment, the instituting of research projects and the realization of research results. The foregoing are but a few of the items which, if reported in this column, would keep all physics departments appraised of the trends in physics and help them plan and promote their post war programs.

The column will be of value only insofar as the news is submitted for it. Its success will depend entirely upon the individual members of the Division voluntarily contributing news. There will be no individual solicitations for news. Until further notice all items for the column should be sent to the Chairman of the Physics Division, J. G. Potter, Department of Physics, Agricultural and Mechanical College of Texas, College Station, Texas or to the Secretary of the Physics Division, C. E. Bennett, Department of Physics, University of Maine, Orono, Maine. Where possible, news should be presented in such form that it can be published in direct quotation. The chairman has appreciated the expressions of opinion he has received in letters from members of the division from time to time. The column will include a digest of such opinion.

The number of new names appearing under "Physics" in the latest annual directory of S.P.E.E. is encouraging. A sincere welcome is extended the new people with the wish that their active participation in the functions of the Division may be of profit to themselves and the profession.

With the attainment of division status, achieved by the group of physicists of S.P.E.E. at the 1944 annual meeting, the group is now in a position to embark on long range programs of service for the advancement of physics instruction. Such programs need not await the resumption of annual meetings. Indeed, their launching should be regarded in the light of an activity replacing that of the annual meeting. The programs may well take the form of committe determination and recommendation of policies on matters such as objectives of engineering service courses, development of appreciation and enthusiasm for physics among engineering students, choices of systems of units to be emphasized in basic courses, promotion of the preparation of suitable texts—especially at the intermediate level—the furtherance of contacts with industry, and content and accreditment of physics curricula appropriate to engineering schools.

Other fields and modes of organized

activity will suggest themselves to members of the Division. The Chairman hereby issues a call to all members for suggestions for division activities and for expressions of interest to participate in specific projects. He will then endeavor, through correspondence, to organize those persons expressing similar interests into effective working units for the exchange and development of ideas. It is recognized that most units will achieve the bulk of their work and deliberations by mail. This column will also serve them. The Division will provide channels for the presentation of results of such work in the JOURNAL and in meetings of the Society, when they are resumed.

A committee on Curricula in Engineering Physics has already been appointed as a result of definite desires for information expressed on the occasion of the last annual meeting. This committee, consisting of C. E. Bennett, University of Maine (chairman), J. W. Woodrow, Iowa State College, and F. L. Partlo, Michigan College of Mines and Technology, and assisted by the Executive Committee of the Division, instituted its activities by circulating a nation-wide questionnaire to determine the exact present status of curricula in engineering physics, or curricula with similar objectives. The extent of the response to this questionnaire has been most gratifying. A complete report of the results will appear soon in a forthcoming issue of the JOURNAL. Considerable interest has been expressed from all sections of the country in the early establishment of such curricula in physics designed to prepare physicists for industry.

It may be of interest to members of the Division to know that a meeting of the Executive Committee of the Division has been held since the last annual meeting. The occasion was the New York meeting of the American Physical Society and the American Association of Physics Teachers, January 19 and 20, 1945. All members of the committee, except one, were present. A major item for consideration was a draft of a constitution and by-laws for the newly organized division, prepared by J. H. Howey, of Georgia School of Technology. It is hoped to present a complete constitution and by-laws for revision or ratification to the next annual meeting of the Division. Other items of business included discussions of material received to that date from the survey on engineering physics curricula and plans for the next annual meeting, subsequently postponed.

The meeting of the American Association of Physics Teachers on this occasion was one of particular significance to S.P.E.E. As a result of successful summer meetings held for the past three years in conjunction with S.P.E.E., the Executive Committee of A.A.P.T. voted to adopt the policy of holding summer meetings of A.A.P.T. regularly with the Physics Division of S.P.E.E. instead of dividing activities between the American Physical Society and S.P.E.E. This should result in better meetings for both organizations, coordination—instead of duplication—of organizational effort, a fuller understanding of the status of physics by engineers, and a clearer appreciation by physicists of the avenues and horizons for physics in engineering and technology.

The meeting of A.A.P.T. was also the occasion for the award of its highest honor, the Oersted Medal, to a member of the Executive Committee of the Division, and of the Council of S.P.E.E., Homer L. Dodge.

THE T-SQUARE PAGE

Officers
JUSTUS RISING
J. L. HILL
I. L. HILL
F. A. HEACOCK
G. M. PHELPS

DEVOTED TO THE INTERESTS
OF ENGINEERING DRAWING

H. E. GRANT, *Editor*
The University of Wisconsin in Milwaukee

Officers
F. M. PORTER
E. C. WILLEY
W. E. STERRY
J. N. ARNOLD
J. M. WOOD
H. C. GRANT

"Education is what is left after what has been learned has been forgotten."

—Anonymous

With this thought in mind let's investigate our courses to see how much education is in them. Do our courses and, for that matter, do all other engineering courses, equip the student with educational values that he can use in the development of new theories now on or beyond today's horizon?

Descriptive Geometry is a course which gives a good accounting of itself on this basis. The fact that it is a theoretical course makes this possible to a large degree. Descriptive Geometry through its theorems and analyses teaches the student to visualize, analyze, reason and think a problem through before starting the problem. The mechanics of solving most of the problems of this course are simple compared to the mental training involved in obtaining the answer.

Because a course has these educational values does not mean they are always developed to the greatest advantage. They may be rendered relatively ineffective by teaching methods emphasizing the mechanics of solving the problems rather than a thorough investigation of the theory from all aspects.

What are the educational values of Engineering Drawing? Most certainly visualization, accuracy, thoroughness, neatness and respect for details are to be found in quantity. The ability to make *beautiful* drawings will be of little value to the graduate in the bulk of the industrial problems required of him. The mastery of making *good* drawings may readily be taught and the reward is a healthy respect for good quality of workmanship in all fields. The considerable extra time required to accomplish *beautiful* drawings should be weighed against the time thereby lost to further analyzation, visualization, etc., qualities essential to the discovery and development of new theories which lie beyond today's horizons.

But in Drawing is the theory of projection divided into its maximum number of theorems or fundamentals as it is in Descriptive Geometry? Is analysis of projection a predominant value of our Drawing courses or is visualization the sole major educational tool for solution of our problems? Our textbooks certainly teach only the latter. A student with poor ability to visualize should be able to analyze his solution and feel confident that it is correct. Every correct line on a drawing is capable of being proved for its right to be there and vice versa every incorrect line can be proved that it does not belong there. The ability to analyze the surfaces and edges of a drawing is a valuable asset and like spatial visualization may be used anywhere.

Although Engineering Drawing is a practical course as compared with Descriptive Geometry the theorems or fundamentals may be divided into their maximum number and taught from an analysis standpoint and this will in turn improve the students' visualization. A complete breakdown of the fundamentals and the development of their accompanying analyses will enable Engineering Drawing to compare much more favorably with Descriptive Geometry.

H. E. GRANT

New Members

Boggs, Robert W., Assistant Manager, General Publicity Dept., Union Carbide and Carbon Corp., 30 East 42nd St., New York City. Re-admission.

Bolds, Myrl, Instructor in Engineering Drawing, Purdue University, Lafayette, Ind. Justus Rising, W. J. Luzadder.

Conta, Bartholomew J., Assistant Professor of Heat Power Engineering, Cornell University, Ithaca, N. Y. S. S. Garrett, M. W. Sampson.

Cook, Marsden A., Assistant Professor of Mechanical Engineering, Rensselaer Poly. Inst., Troy, N. Y. J. S. Fairfield, J. J. Devine.

Forbes, Allen H., Associate Professor of Electrical Engineering, The Penna. State College, State College, Pa. L. A. Doggett, A. P. Powell.

Forsyth, Arthur O., Assistant Professor of Metallurgical Engineering, Univ. of Illinois, Urbana, Ill. H. L. Walker, J. W. Stewart.

Harris, Everett E., Relations Consultant, 430 W. 116th St., New York, N. Y. A. F. Davis, Robert Craeghead.

Harrison, Evelyn, Assistant to Chief, Examining Div., U. S. Civil Service Com., 2515 14th St., N.E., Wash., D. C. E. J. Stocking, P. A. Willis.

Lobingier, George D., Supervisor of Student Recruitment, Westinghouse Elec. Corp., 306 4th Ave., Pittsburgh, Pa. E. B. Roberts, J. C. McKeon.

Loerch, John H., Professor of Engineering, Detroit Institute of Tech., Detroit, Mich. C. C. Winn, L. L. Henry.

Marsh, Malcolm R., Instructor in Civil Engineering, The Rice Institute, Houston, Tex. L. B. Ryon, M. V. McEnany.

Miller, Andrew L., Instructor in Electrical Engineering, Fenn College, Cleveland, Ohio. A. W. Luce, M. B. Robinson.

Morris, Lloyd P., Assistant Research Director, Galvin Mfg. Corp., 2947 N. 78th Ct., Elmwood Park 35, Ill. A. B. Bronwell, R. E. Beam.

Richards, Robert W., Instructor in Civil Engineering, Swarthmore College, Swarthmore, Pa. G. B. Thom, A. H. Repscha.

Rising, James S., Assistant Professor of Engineering Drawing, Rensselaer Poly. Inst., Troy, N. Y. Re-admission.

Sebast, Frederick M., Professor of Electrical Engineering, Rensselaer Poly. Inst., Troy, N. Y. G. K. Palsgrove, S. B. Wiltse.

Smith, Jack, M., Professor of Civil Engineering, Georgia School of Technology, Atlanta, Ga. R. L. Sweigert, R. S. King.

Tracy, Maurice B., Technical Personnel Dept., General Electric Co., 1285 Boston Ave., Bridgeport, Conn. K. P. Hanson, G. S. Timoshenko.

Wanless, Rupert A., Associate Professor of Civil Engineering, Oregon State College, Corvallis, Ore. M. P. Coopey, G. W. Gleeson.

Weigel, Paul, Professor and Head, Dept. of Architecture, Kansas State College, Manhattan, Kansas. Re-admission.

Willard, John A., Partner, Bigelow, Kent, Willard and Co., 75 Federal St., Boston 10, Mass. A. R. Stevenson, S. D. Kirkpatrick.

College Notes

Case School of Applied Science.—On June 6, Case School of Applied Science held an all-day symposium on "Mathematical Analyzers and their Applications in Industry." Included among the speakers were Dr. H. W. Bode of Bell Telephone Laboratories on "Applied Mathematics in Industry"; Dr. H. A. Travers of Westinghouse Electric Corporation, "The Use of the Network Analyzer in the Power Industry"; Dr. Sidney W. McCuskey of Case, "Harmonic Analysis and Synthesis"; H. A. Peterson, General Electric Company, "Solution of Engineering Problems with the Differential Analyzer"; and Dr. Wallace J. Eckert, Director, Watson Scientific Computing Laboratory, Columbia University, "Punched Card Methods in Engineering Computations."

At the luncheon meeting, Dr. William E. Wickenden, President of Case School of Applied Science, acted as toastmaster and Mr. Charles A. Kirk, Vice-President of International Business Machines Company, spoke on "The Influence of Machine Calculating Methods on Industrial Progress."

Professor George L. Tuve has been appointed Head of the Department of Mechanical Engineering at Case School of Applied Science succeeding Professor Fred H. Vose who has served as the Head of the largest engineering department at Case for thirty-one years. Professor Vose will continue as an active member of the teaching staff at Case, but will relinquish his administrative duties.

Dr. Sidney W. McCuskey has been named Levi Kerr Professor of Mathematics and Head of the Department of Mathematics at Case School of Applied Science. The Kerr Chair of Mathematics at Case was previously occupied by Dean Theodore H. Focke and President Emeritus Charles S. Howe.

Dean O. J. Ferguson, College of Engineering, **University of Nebraska**, retired from active deanship on July 1, 1945, having passed retirement age. He has occupied this post since 1920 and thus completes a period of service of twenty-five years. He will retain his post as chairman of the Department of Electrical Engineering to which place he was appointed in 1912.

Dean Ferguson has been a member of S.P.E.E. since 1908, on various committees of which he has had almost continuous place. He was President of the society in 1939–40.

Roy Melvin Green, Assistant Dean of Engineering, Professor of Civil Engineering, University of Nebraska, assumed the duties of Dean on July 1. Dean Green is a graduate of Nebraska, 1914, with a Master's degree from Columbia. He was formerly Professor of Highway Engineering at Texas A. & M. College. He was appointed to the Nebraska staff in 1943, coming from the field of professional practice.

Dean Green is a past president of the Nebraska Engineering Society. Member A.S.C.E., S.P.E.E.; Secy., Nebraska State Board of Examiners

r Professional Engineers and Archi-cts; the author of many papers deal-g with road materials and highway nstruction.

Lauren Earl Seeley has been ap-inted dean of the college of tech-logy at the **University of New lampshire.**

Mr. Seeley was associate professor of mechanical engineering at Yale University where he taught since 1923.

Syracuse University.—Donald E. Stearns has been appointed Professor of Civil Engineering and Chairman of the Department of Civil Engineering in the College of Applied Science, Syracuse University, effective July 1, 1945.

Necrology

MATTHIAS E. HAAS, dean of the College of Engineering at the University of Dayton, died in Dayton on June 5. He had been a member of the university faculty since 1912 as professor of chemical engineering and became dean of the engineering college in 1938.

He was born in Chicago, Ill., in 1888. He received his bachelor of science degree from U. D. in 1912. He also held a master's degree in chemical engineering and a doctor of philosophy degree in chemistry from the University of Pittsburgh.

He served as coordinator of the civilian pilot training program from 1939–1943 and was institutional representative for the government sponsored engineering, science, and management war training courses. He also carried on an extensive plastics testing program in cooperation with the Army Materiel Command at Wright Field.

Dr. Haas was a member of the American Chemical Society, and the Society for the Promotion of Engineering Education since 1935.

Brother ADAM HOFMANN, founder and head of the mechanical engineering department at the University of Dayton, died March 25 in Dayton. He had been a member of the U. D. faculty since 1902.

He was born in New York City in 1875. He studied at Stanislas College in Paris where he majored in mathematics and physics. He returned to the campus in 1902 where he served in various important posts.

He was vice-president of the university in 1908 and founded the mechanical engineering department in 1914. He served for ten years as dean and was head of the mechanical engineering department until his death. He built much scientific equipment for the mechanical engineering laboratories. He joined the S.P.E.E. in 1916.